ANALGESIC AND ANTINFLAMMATORY ACTIVITY OF

PHYT^{EXPONENT}.

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A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF PHARMACY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF PHARMACY DEGREE ,MOUNT KENYA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

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DEPARTMENT OF PHARMACEUTICAL CHEMISTRY.

SEPTEMBER 2021

DECLARATION.

DECLARATION

This research project is solely my own work and has not priorly been submitted for the award of any degree in any institution or for any other award.

Signature …….. Date ……..

SUPERVISOR'S APPROVAL.

I confirm that this project has been submitted for examination with my approval as University supervisor.

DR.EPAPHRODITE TWAHIRWA

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Signature …… Date……

DEDICATION.

I dedicate this work to my family and friends for their enormous support throughout my academic journey in Mount Kenya University.

ACKNOWLEDGEMENT.

I would like to thank God for His helping hand throughout my academic journey. Special gratitude to my supervisor Dr.Epa Twahirwa for his mentorship, guidance and support to ensure that I have successfully completed the project.

A special thank you to Mr Elius Mandela for his guidance and assistance during the laboratory work and also as a source of great advice on different aspects of the project.

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I am sincerely grateful to my dear parents and brother for their support both financially and spiritually that has enabled me to make it this far.Thank you to my friends for their support throughout my academic journey at MOUNT KENYA UNIVERSITY.

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ABSTRACT

Pain and inflammation is unavoidable, despite being protective mechanisms by the body, chronic pain and inflammation can be limiting to a person's daily activities. Chronic pain and inflammation is associated with inflammatory diseases such as rheumatoid arthritis, crohn's disease, asthma, cancer, inflammatory bowel syndromes and neurodegenerative diseases (such as parkinsons disease). The conventional medications used for management of pain and inflammation include non-steroidal antinflammatory drugs (NSAIDS), opiates and corticosteroids among others. These agents are known to have devastating side effects. Due to this more people are opting to use herbal medication as an alternative for management of pain and inflammation. In addition, some inflammatory conditions such as cancer and neurodegenerative disorders such as Parkinson's disease and Alzheimer's, do not have medication to stop or reverse these condition. This has raised the interest of finding new medications for such diseases. The interest of this research study is to find a potential drug for these conditions .In this study the analgesic and antinflammatory effects of phytexponent was evaluated. Phytexponent is an herbal extract mixture of various herbal plants that is marketed as an immunomodulatory agent. Methodology used for analgesic activity was using hotplate method on animal model, where the reaction time to thermal stimulus was recorded after administration of the test drug. For the evaluation of anti-inflammatory activity; formalin-induced paw edema model on mice was used; where the ability of the test drug to show inhibition of inflammation was measured using vernier calipers. The results obtained showed that phytexponent has significant analgesic and antinflammatory activity.

CHAPTER 1: INTRODUCTION

1.1 Background Information

Pain is unavoidable in our day to day lives, it can be limiting in different ways. Since it is a very common ailment, so many analgesics are available. Pain can be of different types: acute, chronic, neuropathic and inflammatory pain, depending on intensity and part of the body affected. Depending on the type of pain, it is irrefutable that this is one of the most extensively researched areas in medicine. However, we cannot deny that most of these medication have serious and sometimes more damaging side effects. We need to also keep in mind that some of these agents also seriously interact with other medication when taken concurrently, because often pain is a symptom of an underlying condition. Inflammation and pain sometimes go hand in hand, it is characterized by redness, swelling, pain and loss of function of the affected area. Often the agents used to manage pain and inflammation are the same. The most common agents used being non-steroidal antinflammatory agents (NSAIDs) which have a fair share of serious adverse effects which include precipitation or aggravation of peptic ulcers. Herbal preparations use on various ailments is gaining traction because of their low incidence of side effects, availability and surprisingly potent activity. The aim of this research project is to find out whether phytexponent which is a multiherbal preparation, has some analgesic and ant inflammatory effect

1.2 Problem Statement

Pain is an enormous global health problem where it is estimated that about 1 in 5 adults suffer from pain and another 1 in 10 adults are diagnosed with chronic pain annually (Public & Priority, 2011).It is one of the most common conditions for which adults use herbal medicine is pain. Medications for pain and inflammation consists of a wide array of agents right from NSAIDS to opioids, they are quite beneficial but are prone to producing severe adverse effects, that may sometimes be harmful than beneficial. Based on previous reports, herbal medicine have been cited as an alternative therapy to conventional drugs pain. Where they have multiple applications for a wide range of diseases including pain and inflammation, and are associated with little or no side effects. (Arome et al., 2014). Herbal products have not been thoroughly researched on, yet they have a potential for a lot of applications on illnesses because of abundance of phytochemicals present in them. This study is aimed at finding out whether the herbal extracts present in phytexponent have any potential analgesic or anti-inflammatory activity .where phytexponent is a multiherbal preparation made of 66% alcoholic extracts of matricaria chamomilla, allium sativum, viola tricolor and echinecea purpurea. Some of these extracts may have analgesic and anti-inflammatory activity that can be used as an alternative to conventional medication.

1.3 Justification.

The use of complementary alternative has greatly increased over the past decades ,where research is slowly being done and more information about the health benefits of herbal medicine is more available (Welz et al., 2018).Patients experiencing pain may try numerous therapies for relief , a survey done found that about 19% of adults suffering from chronic pain had tried using natural products such as; functional foods such as garlic and even animal based supplements (Wirth et al., 2005).All these is in the effort to find a solution that is believed to be natural and has less lethal side effects as compared to conventional medication for management of pain. Due to the concern about side effects of conventional medication such as tolerance and dependence, more research needs to be done on herbal products. These research will help to identify whether certain herbal preparations have analgesic and antinflammatory effects, if present, further studies can then be done to determine the right dosing and identification of possible side effects. Phytexponent is a promising herbal preparation. Containing alcoholic extracts of *Matricaria chamomilla, allium sativum, echinecea purpurea, viola tricolor* and *triticum repens*. It contains extracts of M.chamomilla . allium sativum and echinecea purpurea which separately based on previous research work, have shown analgesic and antinflammatory activity. Its side effects profile is also promising, based on the patent, side effects are mild which ranges from mild diarrhea which stops in a few days to mild dizziness which is attributed to the alcoholic content used to extract. This product has a high potential, some of which are going to be exploited in this research.

1.4 Objectives

1.4.1 General objectives

To investigate the analgesic and antinflammatory activity of phytexponent on mice.

1.4.2 Specific objectives

a. To evaluate the analgesic effects of phytexponent by the use of hot plate model on mice.

b. To investigate the antinflammatory effect of phytexponent using formalin-induced edema observation on the paw of mice.

1.5 Research question

1. Does phytexponent have analgesic activity?

2. Does phytexponent have antinflammatory activity?

CHAPTER 2: LITERATURE REVIEW.

2.1: PAIN.

According to Monheim describes pain as an unpleasant emotional and physical experience that is initiated by noxious stimulus and transmitted over a neural network to the central nervous system where it is interpreted as pain (Kumar & Elavarasi, 2016). This is process is known as nociception. A noxious stimulus is one that is potentially damaging to tissues examples being mechanical stimulus such as pressure, thermal stimulus such as burns and chemicals. Nociception is the process by which intense noxious stimulus are detected by peripheral nerve fibres known as nociceptors (Basbaum and Jessell, 2000). After detection, the noxious stimulus in form of energy (thermal or mechanical) is converted to neural signals in a process known as transduction. The next step of this process of nociception, is transmission where the neural signals are transmitted from the transduction site to the central nervous system consisting of the brain and spinal cord. Perception is the third step, where the neural signals are translated by the higher centres in the brain into pain perception. The final step is modulation, which is where the descending input from the brain influences how the tissue exposed to the noxious stimulus will react. Pain is important since it is a sign of impending danger but it can be limiting when in excess. Chronic pain is persistent pain extends beyond the period of healing, it is limiting where it disrupts sleep and normal living, and ceases to serve a protective mechanism, and instead degrades health and a person's functional capability.(American Pain Society & The Joint Commission, 2010)

2.2 INFLAMMATION.

Inflammation is a protective response of the body that works to eliminate the initial cause of cell injury. This is through the production of an immune response that works to destroy and neutralize the noxious stimulus, removing the damaged tissue and promoting the generation of new tissues (NA;, 2001).By definition inflammation is the local response to cellular injury that is marked by capillary dilatation, leukocytic infiltration, redness, heat, pain, swelling, and often loss of function and that serves as a mechanism initiating the elimination. Inflammation could be caused by noxious stimuli such as:

1. Infective agents like bacteria, viruses and their toxins, fungi, parasites.

2 Immunological agents like cell-mediated and antigen antibody reactions

3. Physical agents like heat, cold, radiation.

4. Chemical agents like organic and inorganic poisons.

Inflammation occurs through various mechanisms; one of the well-known immune responses to a noxious stimulus is the cyclooxygenase enzyme (COX) Pathways that leads to production of prostaglandins that are responsible for the effects of inflammation. At this point it is clear to note how pain and inflammation co-relate, where pain is usually mainly a symptom of inflammation and other underlying conditions. Acute inflammation is usually characterized by immediate vascular changes, a sudden influx of inflammatory cells such as neutrophils and other inflammatory mediators, whereas chronic inflammation is when acute inflammatory mechanisms fail to eliminate tissue injury (Chen et al., 2018). Chronic pain is associated with chronic illnesses such as rheumatoid arthritis, neurodegenerative diseases, diabetes, cardiovascular, cancer, inflammatory bowel disease, asthma, and chronic obstructive lung disease

2.3 CONVENTIONAL METHODS OF PAIN MANAGEMENT.

Pain and inflammation comes about due to cyclooxygenase (COX) enzymes, especially COX 2, which help in the synthesis of prostaglandins (PGs) at the inflammatory site ((Arome et al., 2014)). The released PGs work by sensitize pain receptors to the action of other pain producing substances such as histamine, bradykinin which initiate and cause the nerve cells to send electrical pain impulse to the brain. This mechanism of inflammation produces a suitable target for antinflammatory agents that are the most commonly used, the NSAIDS (non-steroidal anti-inflammatory agents) whose mode of action is by inhibition of the synthesis of prostaglandin (PG), specifically PGE2, by blocking cyclooxygenase (COX). PGs usually lowers the threshold to noxious stimuli by sensitizing the nociceptors to the actions of pain producing modulators (such as bradykinin, histamine, substance P, serotonin)(Thomas M.DeBerardino,2018).According to statistics, it was estimated that about 100 million people worldwide use NSAIDs and therefore are the most widely used drugs ((Bellomo et al., 2017)). Besides NSAIDS, there are other management approaches of pain and inflammation as listed below according to the world health organization;

Figure 2. 1; world health organization pharmacological guideline for pain management.(Bellomo et al., 2017)

With conventional analgesic and antinflammatory agents, adverse effects cannot be avoided. Some the side effects include:

a. NSAIDS Side effects: Nausea, indigestion, bleeding from the stomach, peptic ulcer, and bronchospasm .

b. Side effect of narcotics analgesic drugs: Euphoria, tolerance, nausea, vomiting, and sedation

c. corticosteroids are divide into glucocorticoids and mineralocorticoids , and these too have serious side effects such as exercerbation of diabetes, skin thinning and neuropsychiatric side effects (such as euphoria, aggression, insomnia, mood fluctuations), acne, mild hirsutism, impaired wound healing, thinning of hair , hepatic steatosis (fatty liver) among many other serious side effects. Some mineralocorticoid side effects include fluid retention, edema, weight gain, hypertension, and arrhythmias by increasing renal excretion of potassium, calcium, and phosphate.

2.4 TRADITIONAL HERBAL EXTRACTS FOR MANAGEMENT OF PAIN AND INFLAMMATION.

Herbal medicine can be used as an alternate treatment of diseases which involves the use of different plants and their extracts. WHO approximated that about 75-80% of the world population is reliant on herbal medicines (Sen et al., 2010) Owing to the dangerous and sometimes life threatening side effects of conventional analgesics and antinflammatory medications, many people are opting to employ the use of alternative options of managing these conditions. The WHO states that Traditional and complementary medicine (T&CM) is often an

underestimated health resource with many applications, especially in the prevention and management of lifestyle-related chronic diseases, such as chronic pain and in meeting the health needs of ageing populations. Due to this it is important to research on various herbal preparations that have shown potential health benefits.

2.5 PHYT^{EXPONENT}.

Phyt^{exponent} is a Belgium-manufactured poly-herbal preparation that is both versatile and powerful, that consists of five herbs that is *Echinecea purpurea, Matricaria chamomilla, Triticans repens, Allium sativa* and *Viola tricolor.* Of these five herbs; Viola tricolor, Matricaria chamomilla and Echinacea purpurea extracts have demonstrated quite a potential of possessing analgesic and antinflammatory activity(Manayi et al., 2015).

2.5.1 Echinecea purpurea (purple coneflower)

Purple Coneflower is an herbaceous perennial plant that belongs to the Asteraceae (daisy) family that is native to central and eastern USA. It produces purple- pinkish flowers and can grow up to 3 to 4 feet. It is known to have important immunostimulatory and anti-inflammatory properties. This species has mainly been used in chemo-preventive and chemotherapy for infectious diseases in both upper and lower respiratory systems((Manayi et al., 2015)) . in an experiment to evaluate its antinflammatory activity; Carrageenan-induced paw edema model in experimental animals done using Dried root powder of the plant, administered to the mice (30-100 mg/kg), inhibited the paw edema similar to indomethacin. This effect could be attributed to the inhibition of COX-1 and to some extent COX-2 by alkamides (a phytochemical found in echinecea). The ethanol extracts of this plant are the most effective in inhibiting the resultant effect of fibrinoblast activity(Manayi et al., 2015).

2.5.2 Matricaria chamomilla. (German chamomile*)*

It is an annual herbaceous plant that belongs to the Asteraceae family. Its characteristics are; a smooth stem that reaches a height of 8-36 inches (20-92cm) and has shallow roots. They have flowers with white petals and a conical yellow center. *Matricaria chamomilla* has therapeutic properties as anti-inflammatory properties, anti-fungal and bacteria. These activities could be attributed to the existence of phytochemicals such as sesquiterpenes and flavonoids (Siadat & Direkvand-moghadam, 2016).

2.5.3 Allium sativum (garlic)

It is a perennial bulbous plant of the amaryllis family (Amaryllidaceae), the bulbs have a powerful aroma that is onion-like and a pungent taste. In some cultures around the world is the most important preventive remedy, a universal spice and food, a well-trusted remedy.Numerous research works have shown the immunomodulatory and immunotherapeutic potentials of garlic; which includes free radical-mediated anti-inflammatory, anticancer, and antiangiogenic effects,infectious diseases, autoimmune diseases, and allergy.Based on previous research it is known that an aqueous garlic extract ,exerts antioxidant action through scavenging of reactive oxygen species (ROS)(Arreola et al., 2015).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study extract

Phyt^{exponent} plant based natural product was be used in this study. It was provided by my project supervisor Dr. Epaphrodite Twahirwa pharmaceutical chemistry lecturer in the school of pharmacy. The storage of this product was as per the instruction outlined on the package by the manufacturer.

3.2 Experimental animals

Swiss albino mice of weight range 26±2 and age of four to six weeks were used in this study. The study mice comprised of both gender and were obtained from the animal breeding house located in Jomo Kenyatta University of agriculture and technology. From this point they were properly transported in covered cages to the animal house in Mount Kenya University. While in the animal house they were maintained under standard conditions that included 12- hour day and night cycle, room temperature of 27 ± 2 and free access to water and rodent pellets. Wood shavings or rice harks were used as beddings in the cages and were changed on a daily basis. The acclimatization period to the new environment was three days prior to the study day. All the guidelines regarding the use of animals in a study were followed.

3.3 Analgesic activity of the phyt^{exponent}

The analgesic potential of the phyt^{exponent} was investigated by the hotplate method. The protocols described by Lopes et al. (2019) were followed with some modifications. Prior to the study healthy animals to be used were fasted overnight by depriving off food and water. These animals were then sorted out and grouped in five groups with each group having five mice (n=5); negative control, positive control and three experimental groups. Respective groups will be

marked differently and housed in different cages. The phyt^{exponent} was administered orally in three different doses; 100%, 50% and 25%. Diclofenac (10 mg/kg BW) was used as the standard analgesic and it was as well administered orally. Pain was as a result of thermal stimuli was initiated by placing each mouse on a hotplate set at 50 ± 2°C. Each mouse was placed on the hotplate at an interval of 15 min, 30 min and 45 min after the oral administration of phytexponent at different doses 100, 50 and 25 % and diclofenac 10 mg/kg bw. Paw licking, shaking and jumping of the mouse was taken as the response of the mouse to pain as a result of thermal stimuli. The time taken by each mouse prior to responding to the thermal stimuli was taken as three reaction time with the cutoff time being 15 seconds.

3.4 Anti-inflammatory activity of the phyt^{exponent}

The anti-inflammatory activity of phyt^{exponent} was conducted by formalin test as described by Zhao et al.(2018) with minor modifications. Study animals were segregated into five different groups: negative control, positive control and three treatment groups. Three doses of the phyt^{exponet} (100%, 50 % and 25 %) and indomethacin at 10 mg/kg BW were prepared in normal saline and orally administered to the respective groups. Using vernier caliper the size of the right hind paw was measured and recorded. One hour after the administration of the phyt^{exponent}, indomethacin and normal saline to the respective groups, formalin at dose of 2 % v/v prepared in normal saline was administered by sub-planner injection in the right hind paw. 30 minutes later, paw size of the right hind paw was then measured using vernier caliper and the size recorded. The percentage inhibition of paw edema was calculated using the formulae;

$$\%\ inhbition\ of\ Paw\ edema\ = \frac{Paw\ size\ \ formalin - paw\ size\ before\ formalin}{paw\ size\ before\ formalin\ injection} \times 100$$

3.5 Data management and statistical analysis

The data from the analgesic and anti-inflammatory activities that will consist of the reaction time and the percentage inhibition values will be noted in the research laboratory notebook. All the values will then be fitted in the excel spread sheet prior to exporting in the graph pad prism for analysis. Upon descriptive statistic the results will be presented as Mean ± SEM (standard error of the mean). Further analysis by two-way anova will be followed to determine the level of significance between the different means.

3.6 Ethical consideration

Prior to conducting this study, research conduction permission was sought from the Mount Kenya university ethical review committee. Upon grant of permission to conduct the study, all the set guidelines pertaining use of animals were adhered to the latter.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Results

4.1.1 The anti-inflammatory activity of the phytexponent

The anti-inflammatory activity of the phytexponent was assessed using formalin test. The results of the study are as outlined in figure 4.1 and table 4.1. The injection of formalin in the paw resulted in swelling that increased the paw size. The results showed administration of indomethacin at dose level of 10 mg/kg reduced the paw size significantly as compared to the negative control. However, the reduction was not significantly different from the activity showed by phytexponent at 100%. phytexponent at 100% did not show a significant reduction in paw size as compared to the positive control (indomethacin 10mg/kg). The administration of the phytexponent reduced the paw size in all the three doses (100%, 50% and 25%) used when compared to the negative control. The phytexponent at 100 % reduced the paw size more as compared to both 50% and 25 % respectively. The reduction shown by phytexponent at both 50 % and 25 % was not significantly different from each other.

TEST GROUPS	MEAN+/- SEM	PERCENTAGE INHIBITION.

Table 4. 1: showing anti-inflammatory effect of phytexponent

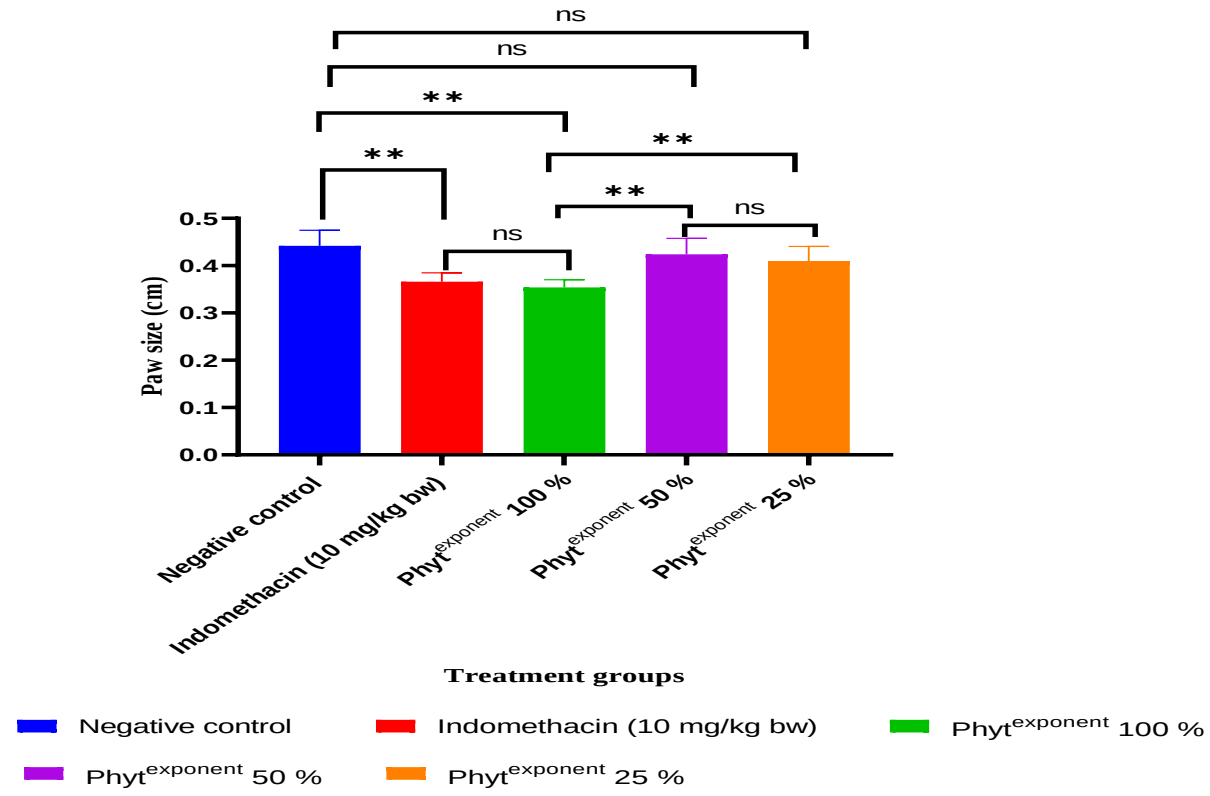

Figure 4. 1: anti-inflammatory effect of phy^{texponent}

NEGATIVE CONTROL	0.442 +/- 0.033	0%
POSITIVE CONTROL	0.366 +/- 0.019	17.19%
PHYTEXPONENT 100%	0.354+/- 0.016	19.91%
PHYTEXPONENT 50%	0.424 +/- 0.034	4.07%
PHYTEXPONENT 25%	0.410+/- 0.030	7.24%

4.1.2 Analgesic activity of phytexponent

The administration of normal saline (negative control) did not result in any change in the reaction time to respond to the thermal stimuli. Diclofenac at a dose level of 10 mg/kg BW increased the reaction time to the thermal stimulus more as compared to the normal saline. The administration of the phytexponent at all the three study doses (100%, 50% and 25%) resulted in an increase in reaction to the thermal stimuli after 45 minutes. From figure 4.2, the phytexponent at higher dose of 100% increased the reaction time more as compared to 50% and 25% across all the monitoring period. The administration of the phyt^{exponent} at doses 50% and 25 % resulted into reverse activity as the lower dose of 25 % recorded more reaction time in response to the thermal stimuli as compared to the 50% dose. At 15 minutes, 30 minutes and 45 minutes monitoring periods no significant difference was noted in the reaction time recorded between the experimental groups administered with 50 % and 25 % ($p>0.05$; Fig 4.2).

The comparison of the reaction time recorded group wise at each monitoring period showed that the ability of the mice to withstand the thermal stimuli increased with increase in time after administration of the phytexponent and diclofenac. The administration of the diclofenac showed no significant difference in the reaction time recorded between zero minutes and 15 minutes and between 30 minutes and 45 minutes ($p>0.05$; Figure 4.3). However, after 30 minutes, diclofenac showed a significant increase in reaction time significantly as compared to reaction time at 15 minutes ($p<0.05$; Figure 4.3).

The administration of the phytexponent at dose level of 100 % resulted into no significant difference in the reaction time recorded between 30 minutes and 45 minutes. However in the rest of the monitoring period (at 0 minutes and 15 minutes) a significant difference was noted in the

reaction time recorded ($p<0.05$; Figure 4.3). The administration of the phytexponent at both 50 % and 25 % dose levels showed no significant difference in the reaction time recorded between 15 minutes and 30 minutes and between 30 minutes and 45 minutes respectively ($p>0.05$; Figure 4.3). Similarly the administration of the phytexponent at a dose of 50 % recorded no significant difference in the reaction time recorded between 0 minutes and 15 minutes ($p>0.05$; Figure 4.3). For the two doses (50% and 25%) of the phytexponent in the remaining monitoring period a significant difference was noted in the reaction time recorded.

Figure 4. 2: Analgesic activity of phytexponent through hotplate test

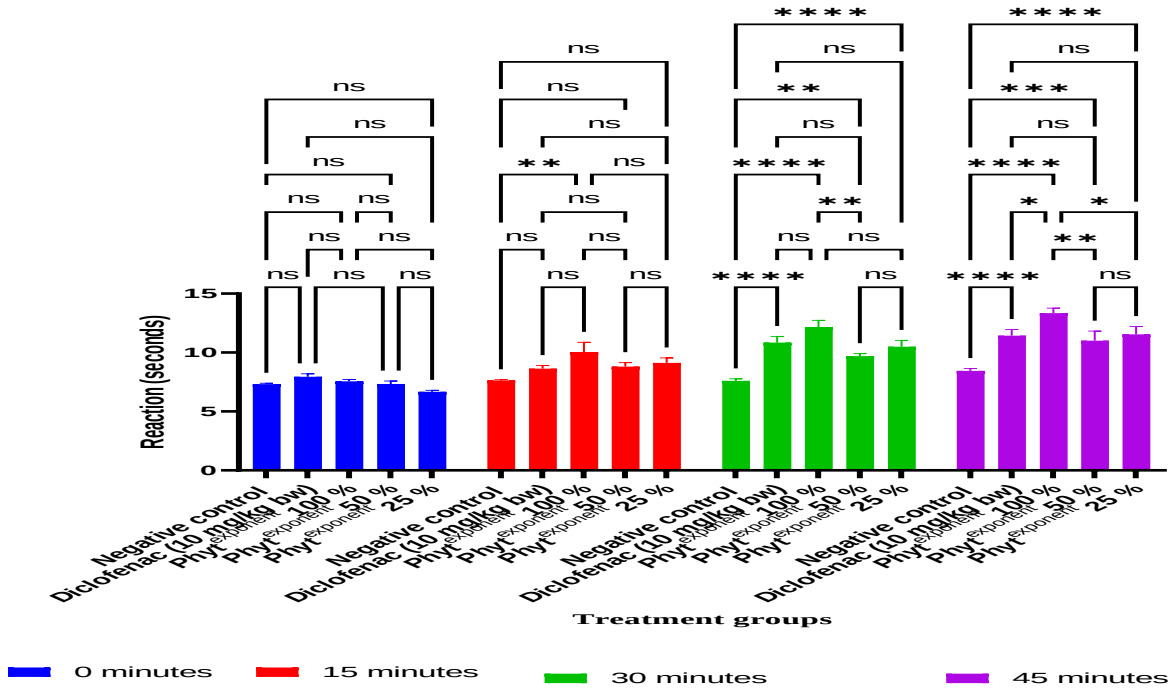

Figure 4. 3: Analgesic activity of phytexponent through hotplate test

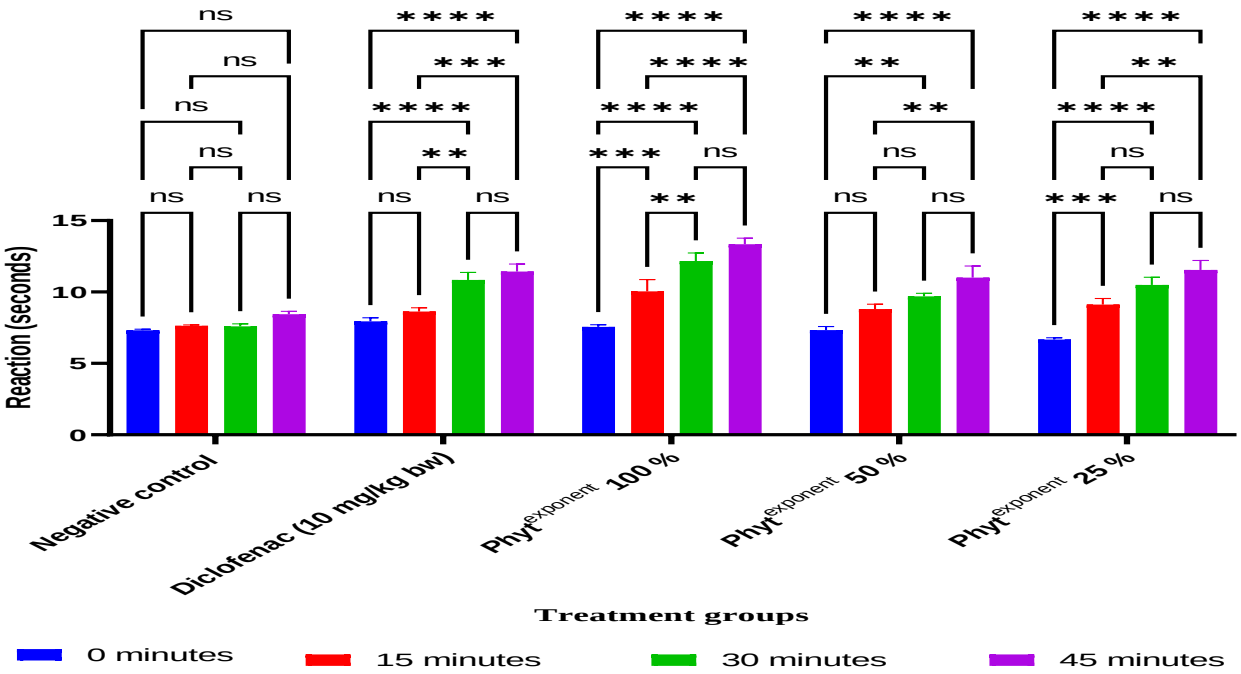

Table 4. 2; analgesic activity of phytexponent.

TEST GROUPS	Reaction time in seconds (mean +/- SEM)			
	0 minutes	15minutes	30 minutes	45 minutes.
NEGATIVE CONTROL	7.320 +/- 0.0680	7.632 +/- 0.066	7.590+/- 0.182	8.444+/- 0.203
DICLOFENAC (10mg/kg bw)	7.940+/- 0.255	8.632+/-0.256	10.842 +/- 0.525	11.430+/- 0.523
PHYT^{EXPONENT} 100%	7.5560 +/- 0.1440	10.046 +/- 0.823	12.168 +/- 0.558	13.346+/- 0.417
PHYT^{EXPONENT} 50%	7.3260 +/- 0.2570	8.804 +/- 0.341	9.690 +/- 0.220	11.000 +/- 0.819
PHYT^{EXPONENT} 25%	6.6640 +/- 0.1340	9.124 +/- 0.416	10.498+/- 0.535	11.538 +/- 0.671

4.2 Discussion

Inflammation is the body's protective measure from harmful stimuli such as foreign particles and infections. One characteristic sign of inflammation is pain which is usually indicative of embedding danger. Persistent pain is usually uncomfortable and urgent prevention is important to avoid pathological conditions. Conventionally many analgesics of synthetic nature are used to relieve pain and function as per various mechanisms. Reduced potency and side effects has been the characteristic of these conventional analgesics and anti-inflammatory drugs rendering them less preferred (Koech et al., 2017). The history of traditional medicine from plants is very rich and has been embraced in recent days. As alternatives to the modern medicines has seen more research in this area increase. In the current study the analgesic activity and anti-inflammatory activity of the phyt^{exponent} was evaluated. The hotplate method which investigates the analgesic agents with central pain inhibition mechanism (Ajaib et al., 2017).. Phyt^{exponet} was seen to be able to inhibit pain induced by thermal stimuli as a result of heat from hotplate set at 50 ^{0} C in a reverse order. The highest inhibition of pain was observed at 100 % dose level of the phyt^{exponent}. However, this was not clear if it was as the effect of the high ethanol content present in the undiluted phyt^{exponent}. The phyt^{exponent} at 25 % dose level inhibited pain more as compared to phyt^{exponent} at 50 % dose level. The analgesic activity was increasing as the duration after administration of the phyt^{exponent} and diclofenac was increasing.

Anti-inflammatory potential of the phy^{exponent} was evaluated by formalin test. In this test formalin induced edema in the right hind paw and the ability of indomethacin or phyt^{exponent} to reduce the edema was observed. Oral administration of indomethacin was observed to have reduced the paw edema more as compared to the phyt^{exponent} at both 50 % and 25 % respectively. However, at phyt^{exponent} at 100 % dose level reduced the paw edema as in the same manner as indomethacin.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion; according to this research it was concluded that phytexponent has both analgesic and antinflammatory activity. This therefore confirms that phyt^{exponent} can be considered as an analgesic and antinflammatory agent once the right doses to be taken have been confirmed.

5.2 Recommendations

The following recommendations should be made based on this study;

1. The evaluation of the toxicity of phytexponent at 100 % should be thoroughly done.
2. The analgesic and anti-inflammatory activity at concentrations lower than 25% be evaluated, in order to determine whether these activities are concentration dependent.

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Appendices.

swiss- albino mice used in both models.

Hotplate set up during test for analgesic activity.