Assessment of the Analgesic Activity of Musa Paradisiaca Linn Peels of the Family Musaceae

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Abstract

Pain is the body's alarm system and is triggered in the nervous system. It signals that something is wrong. It may be sharp or dull, it may come and go, or it may be constant, in one part or all over the body. The *Musa paradisiaca* (L.) family Musaceae, commonly known as banana in English, is a perennial tree like herb grown indigenously in tropics and subtropics and also cultivated commercially in India for its fruits. The objective of this research is to assess the potential analgesic activity of *M. paradisiaca* Linn peels. Two methods were used for the evaluation of analgesic activity namely; Hot Plate Method and Tail Immersion Method. Results revealed that there were significant effect on the analgesic capability of the aqueous extract of *M.paradisiaca* L. both in 100 mg/kg and 200 mg/kg, and Morphine ($p<0.05$), indicating a significant difference on the analgesic potential between aqueous extracts and standard morphine, both under the Hot Plate and Tail Immersion Methods. The results also revealed a statistically significant interaction between the effect on treatment groups and time, with a $p<0.05$. Under the Hot Plate Method, the results revealed a no significant effect on the time interval of the aqueous extract of *M. paradisiaca* L. both in 100 mg/kg and 200 mg/kg, and morphine ($p>0.05$), signifying that aqueous extracts, both in 100 mg/kg and 200 mg/kg, and morphine had the ability to exert optimized analgesic potential regardless of time. However, under the Tail Immersion Method, the result also revealed a significant effect on the time interval of the aqueous extract of *M. paradisiaca* L. both in 100 mg/kg and 200 mg/kg, and morphine ($p>0.05$), signifying that aqueous extracts, both in 100 mg/kg and 200 mg/kg, and morphine had significant difference on the optimum time interval to exert the highest analgesic capability.

Key words: *analgesic, banana, peels, morphine, pain, Swiss albino mice, Musa paradisiaca*

INTRODUCTION

Background of the Study

Several studies had been made for the use of plant as the source of medicines by using their roots, leaves, stems, barks, flowers and fruits of plants. In this study, the researchers will be evaluating the peels of *Musa paradisiaca* Linn (Fam. Musaceae) for its possible analgesic effect.

Pain is the body's alarm system when something is wrong. It is a feeling triggered in the nervous system. It may be sharp or dull, it may come and go, or it may be constant. It may be felt in one part or all over the body.

Pain can be treated in so many ways. Though treatment varies depending on the cause of pain, pain relievers, acupunctures, and surgery are sometimes helpful. Under-treatment of pain is a poor medical practice that results in many adverse effects.[1][2]

Pain relief as an international human right is recognized, but there is no express pain management mentioned, its implementation is being looked at. The International Covenant on Economic, Social and Cultural rights articulates the right "of everyone to the enjoyment of the highest attainable standard of physical and mental health" and WHO defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Adequate provision of pain management comfortable falls within these provisions.

Objectives

The general objective of this study is to assess the potential analgesic activity of *M. paradisiaca* Linne peels. The specific objectives of this study are as follows: First, provided that the aqueous extract of the *M. paradisiaca* do posses analgesic capability, the researchers would like to determine if there is a significant difference between the analgesic activity of the extract, the vehicle and standard drug. And, provided that the aqueous extract of the *M. paradisiaca* do possess analgesic capability, the researchers would like to determine the optimum time interval of the extract to exert the highest analgesic capability.

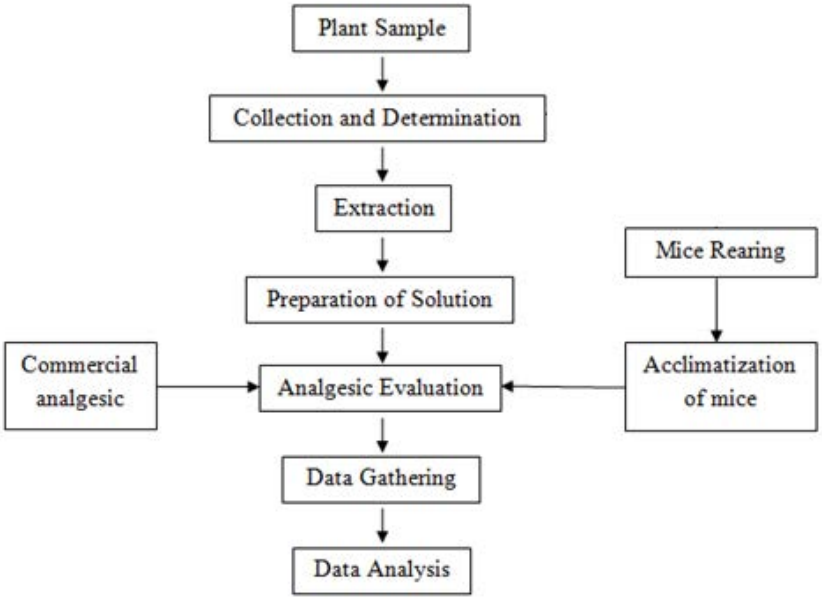

Fig. 1: Research Paradigm

The figure shows the steps on how the researchers executed the whole research. The activities done ranged from collection and determination of materials, preparation of extracts, preparation of solution for testing, evaluation of analgesic activity of both the commercial analgesic and the extract on acclimatized mice, up to data gathering and analysis using suitable statistical treatments.

Statement of the Problem

The Philippines possess varied natural resources which can be made into medicinal products. The researchers aims to answer the following questions:

1. Do the *M. paradisiaca* Linn peels possess analgesic activity?
2. Does it possess significant analgesic activity?
3. Is there a significant difference between the analgesic effects of the aqueous extract of the *M. paradisiaca* in varying time points?

Hypothesis

All statements were formulated in null form, reflecting the probable answers for the problems stated.

1. The extracts of *M. paradisiaca* Linn peels possess no significant analgesic activity.
2. There is no significant difference between the analgesic capabilities of the aqueous *M. paradisiaca* extract, vehicle and the standard drug.

Significance of the Study

The materials used in this study were considered wastes and of no use. These materials can be made into more productive material if proven to exhibit the activity being evaluated for. This study regarding the peels of *M. paradisiaca* Linn will be significant to the Public Health as this would serve as another breakthrough in the field of medicine.

This study may also serve as a guide and basis for students who may wish to continue and improve the research. It will also help the other professionals to spread the information on educating the public about the *M. paradisiacal.*

This study will also be significant to other researchers as they may continue this study to prove more about the *M. paradisiaca* Linn peels.

Scope and Limitation

The study assessed the potential analgesic activity of yellow-colored *M. paradisiaca* Linn peels, locally known as Saba. Collection of samples were conducted in chosen local markets within Metro Manila. The chemical composition of the peel was not determined in the study.This study was conducted at the School of Pharmacy Laboratory of Emilio Aguinaldo College-Manila. Instruments used came from the EAC-School of Pharmacy and/or from other institution, if needed.

REVIEW OF RELATED LITERATURE.

The healing power of plants have been known to man for generations.[3] Plant drugs are frequently considered to be less toxic and free from side effects than the synthetic ones.[4]

Plant used for evaluation: *M. paradisiaca* Linn. *(*Family Musaceae)

M. sapientum Linn, also known as Saba, is a herbaceous flowering plant with a height of 6 to 7.6 meters. The leaves that are spirally arranged which grows up to 2.7 meters long and 60 cm wide. [5] Studies suggest that *M. sapientum* Linn possess many therapeutic activities.

M. sapientum Linn exhibit many pharmacologic activities. [6][7][8] The dried powdered pulp of the banana has an anti-ulcerogenic activity against ulcers induced by histamine in guinea pigs and prednisolone in rats. [9][10][11][12] The roots are used as antihelmintic while the peel and the pulp contain antibiotic and antifungal activity. [13] It also has a hypoglycaemic activity. [14] The fruit contains starch and carbohydrates in 20% to 50% in the pulp.

M. sapientum Linn has anti-diabetic activity. [15] In the traditional medicinal systems of India, all the parts of *Musa* spp. (Family Musaceae) are used for the treatment of various diseases.[13] Extensive investigation have proved the anti-ulcerogenic, ulcer healing activities and wound healing activity of plantain banana.[16][17] Medicinal uses of banana (*Musa* spp. in general): Flower's extracts used to treat bronchitis, dysentery and on ulcers, Cooked flowers syrup used against Diabetes, Astringent plant sap used as a medication to cure hysteria, epilepsy, leprosy, fevers, hemorrhages, acute dysentery and diarrhea, and on hemorrhoids, insect and other stings

and bites; whereas young leaves used as poultices on burns and other skin afflictions; the astringent ashes of the unripe peel and leaves works against dysentery, diarrhea and malignant ulcers; Roots are an age-old application in digestive disorders, dysentery and other ailments and Seed mucilage cures ophthalmic cataracts and diarrhoea.[13][18]

The pulp of the *M. sapientum* var. *paradisiaca* was studied to have an anti-ulcer effect and mucosal defensive factors for Normal and Non-Insulin Dependent Diabetes Mellitus (NIDDM). It was claimed that the ulcer protective and anti-diabetic effect of *M. sapientum* var *paradisiaca* is better compared to Sucralfate and Glibenclamide.[18]

Musa paradisiaca (L.) (Musaceae) commonly known as banana in English, is a perennial tree like herb grown indigenously in tropics and subtropics and also cultivated commercially in India for its fruits.[19]

The various effects of *M. paradisiaca* Linn. are documented in traditional as well as scientific literature. The main pharmacologial effects of this plant are- Hepatoprotective, hair growth promoter, diuretic, analgesic, antiulcer, wound healing, antioxidant, hypoglycemic, antiurolithiatic activity, mutagenic effects and haemostatic activity in which few are reported.[20]

The analgesic activity of aqueous extract of the plant was evaluated using the hot plate method and writhing test in mice. The hot plate method is useful in detecting centrally acting analgesics whereas acetic acid induced writhing method is useful to detect peripheral analgesic effects. Acetic acid, which is used as an inducer for writhing syndrome, causes analgesia by liberation of endogenous substances, which then excite the pain nerve endings. The fact that aqueous extract of *M. paradisiaca* showed analgesic activity in both the models studied, indicate that this effect could be due to the presence of two components; one acting centrally and the other via peripheral route from the above results, it can be deduced that aqueous extract has shown dose dependent activity. As the phytochemical screening has shown the presence of carbohydrates, sterols, proteins, flavonoids, alkaloids in aqueous extract of *M. paradisiaca* leaves, its potent activity may be attributed to the presence of these phytoconstituents.[21]

Investigation with unripe bananas showed that it contains high anti-microbial activities. Unripe banana had more antibacterial activity when used with two different solvents, water and ethanol, compare to lemon grass and turmeric that had good anti-microbial activity with only ethanolic extract.[22]

M. sapientum L. Extract was claimed to be a weight-gain reducer. It alters the phospholipid content of the stomach and the duodenum.[23]

Hot plate and tail flick tests are most sensitive methods to centrally acting analgesics. The stem of *M. sapientum* L. possesses potential analgesic activity in both ethanolic and water extracts.[24]

Methods to be used for the analgesic activity of *M. paradisiaca L (*Family Musaceae): Hot plate Method and Tail Immersion Method.

The hot plate test is a simple behavioural screen for estimating the effects of test substances on the threshold for pain sensitivity. It is based on the principle of the rodents' responses while being placed onto a hot surface. The principal parameter assessed in the hot plate test is the latency to the first paw-lick response.[25][26]

Hot plates are a very convenient source of heat. The change in temperature occur somewhat slowly, thus making it good way for testing pain sensitivity.[27]

The Tail-Immersion Method, however, is based on the principle of the tail of the rodents soaked into a water bath with a constant temperature. The principal parameter of assessment is the first flicking of tail within a time limit.[24]

A hot water bath is a very effective source of heat when a temperature below 80^{o}C is required. A beaker (250mL or 400mL) is partially filled with water and heated on a hot plate to regulate the temperature. A thermometer is clamped into position in the water bath to allow the monitoring of the temperature.[25]

Animal species: Swiss Albino Mice

A particular in-bred strain implies that mice must live long enough to produce offspring, but beyond that minimal requirement there are great differences between strains in characteristic lifespan. According to Comfort (1959), the typical lifespan of mice in various strains is ranging from 1.3 to 3 years. Mice from strains having the shortest lifespan are usually extremely susceptible to a specific kind of neoplasm. On the other hand, certain long-lived strains and hybrids have been much favoured in radiation experiments.

The widely distributed Swiss albino mice, largely non-inbred, are mainly derived from two males and seven females which Clara J. Lynch of the Rockefeller Institute obtained from A. de Coulon of Lausanne in 1926. Random-bred mice are more widely used than either in-breds or hybrids in commercial assay work, where the cost is also considered other than the sensitivity. In acclimatization, eating is cyclic and well known to all mouse breeders, for the sound of gnawing on pellets becomes audible in the mouse quarters late in the day. The cereal foods such as rolled oats, oatmeal, whole and ground rice, macaroni, and vermicelli are the first food of choice for mice based on the first supplies to be attacked on a well stocked grocery store. Drinking, like eating, is cyclic and occurs mostly during the night. Mice given water *ad libitum* typically consume 4 to 6 ml each 24 hours. Mouse breeders are also well aware of the propensity for fighting shown by many strains, particularly by males. Severe wounds are inflicted in combat, and battles to the death are not uncommon. Laboratory mice housed in cages typically develop a social organization based upon exclusive dominance of one male. Courtship follows a pattern similar to that of other laboratory rodents but has species-specific characteristics. The basic sequence consists of elements described as sniffing, following, mounting, mounting-with-intromission, and post-copulatory grooming. In relation to the maintenance conditions for the mice, temperature control is widely regarded as essential in the animal room. Mice, however, can adapt successfully to temperatures as low as -3^{o}C provided that ample nesting materials are provided. [28]

Morphine

Morphine is classified under the category of opioid analgesics. It is one of the classic opioids often used as a standard to measure comparative potency among opioid drugs. Morphine interacts with other drugs, such as inhalants and injectable anaesthetics and analgesics, to reduce the overall necessary dose of anaesthetics or analgesics. Regardless of route of administration, morphine has a relatively short duration of action, thus limiting its use in a laboratory animal setting wherein a 24-hour intensive care is not routinely provided. In rats and mice, 10mg/kg of morphine provides analgesia adequate to relieve severe pain for only 2 to 3 hours. More complete analgesia can be achieved if morphine is administered with acetaminophen. [29]

METHODOLOGY

Plant Materials

The researchers were able to prepare 500g of dried *M. paradisiacal* Linn peels from the collected peels from local markets and banana cue vendors within selected areas by cutting them into bits, after thoroughly washing them in running water. These were air-dried under shade for 1 week, and then subjected it to oven-drying at 105^{o}C for 5 hours. The dried samples were then macerated with about 1.5L of water to ensure that the samples were immersed into the water, for 24 hours, with intermittent stirring. After maceration, the mixture was filtered to collect the extract. The extract then collected amounted to 759 mL. This was evaporated until viscous character was obtained. The evaporated extract weighed 144.21 g, with a yield of 28.84 %. From this concentrated extract, 500mL solution with a concentration of 10mg/mL was prepared.

Test Animals

Albino Mice weighing from 20g to 25g were used. The animals were subjected to veterinary check-up to make sure that they are healthy. The animals were acclimatized to the laboratory conditions for not less than 10 days after their arrival. The animals were housed in groups under standard light/dark cycle of 12/12 hours with food and water provided *ad libitum*.

Food was withdrawn six hours prior to drug administration till completion of the experiment on the day. All experiments were performed during the light period.

Administration of Standard Drug, Vehicle, and AMP

The administration of the AMP was done at the rate of 100mg/kg and 200mg/kg in mice. The vehicle dose was 5ml/kg. The standard drug, morphine was administered at a dose of 10mg/kg. All administrations were done intra-peritonially.

Experimental Method

1. Hot Plate Method

Swiss albino mice were divided into four groups each containing five animals. The hot plate was maintained at 55^{o} to 56^{o}C. The animals were placed on the hot plate and the time until either licking or jumping occurs were recorded by a stop-watch, with an interval of 0, 15, 30, 60 and 90 minutes after vehicle, standard and test drug administrations. The test was limited up to 15 seconds to prevent tissue damage.

2. Tail Immersion Method

Swiss albino mice were divided into four groups each containing five animals. The tail of the mouse was immersed to a constant level of 3cm in a water bath maintained at 55±0.5^{o}. The time to flick-the-tail from the water was recorded. A maximum immersion time of 30 seconds was set as the limit to prevent thermal injury to the animals. A significant increase in reaction time compared with control animals was considered a positive analgesic response.

The experiments was conducted in three trials.

Statistical Analysis

All results were expressed as mean ± SEM. The comparison of the results from the extract and standard drug to the vehicle were analyzed statistically using Two-Way ANOVA.

RESULTS AND DISCUSSION

This chapter aims to present all of the results obtained by the researchers throughout the study. This chapter presents the study through the use of tables.

The researchers were able to prepare 500mL solution of extract with a concentration of 10mg/mL. The solution was prepared from 144.21g of extract, having a yield of 28.84%

After conducting the experiment, the researchers were able to obtain varying results from the *M. paradisiacal* L. extracts of doses 100mg/kg and 200mg/kg. Results were also obtained from Morphine and the vehicle.

Treatment	0	15	30	60	90
Morphine	12.86±0.19	6.67±0.31	6.68±0.25	9.83±0.33	11.11±0.24
Vehicle	3.66±0.65	3.39±0.69	3.7±0.35	5.24±0.75	3.56±0.80
100mg/kg	5.04±0.27	5.34±1.69	5.13±0.38	4.95±0.65	3.41±0.49
200mg/kg	5.52±0.77	9.45±1.02	6.57±1.35	4.69±0.24	4.86±0.36

Table 1 Hot Plate Test Results

Treatment	0 (sec)	15 (sec)	30 (sec)	60 (sec)	90 (sec)
Morphine	1.81±0.23	2.68±0.30	2.71±0.23	2.49±0.38	1.93±0.24
Vehicle	2.66±0.65	1.27±0.09	1.44±0.08	2.02±0.12	1.49±0.15
100mg/kg	1.69±0.29	1.29±0.02	1.79±0.18	2.28±0.43	1.44±0.13
200mg/kg	1.59±0.22	2.07±0.38	3.34±0.67	2.15±0.37	1.54±0.20

Table 2 Tail Immersion Test Results

A two-way Analysis of variance (ANOVA) was conducted to determine the difference between the analgesic effects of the aqueous extract of *M. paradisiaca* L. based on the standard drug, morphine and the time interval of the extract to exert the highest analgesic capability. Shapiro-Wilk test was used as a numerical means of assessing normality in parametric testing and this was further verified using Kolmogorov-Smirnov test. The test revealed a statistically no significant normality for the treatment groups, and the time intervals.

		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Treatment	Statistic	df	Sig.	Statistic	df	Sig.
Trials	Morphine	.182	15	.192	.900	15	.097
	Vehicle	.197	15	.122	.921	15	.198
	100 mg/kg	.176	15	.200(*)	.906	15	.117
	200 mg/kg	.208	15	.080	.917	15	.174

Table 3 Kolmogorov-Smirnov and Shapiro-Wilk Test for treatment groups for Hotplate method

		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Time	Statistic	df	Sig.	Statistic	df	Sig.
trials	0	.287	12	.007	.814	12	.013
	15	.109	12	.200(*)	.960	12	.785
	30	.155	12	.200(*)	.966	12	.867
	60	.237	12	.061	.865	12	.056
	90	.295	12	.005	.829	12	.021

Table 4 Kolmogorv-Smirnov and Shapiro-Wilk Test for time intervals for Hotplate method

		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Treatment	Statistic	df	Sig.	Statistic	df	Sig.
trials	Morphine	.190	15	.155	.900	15	.097
	Vehicle	.195	15	.131	.921	15	.198
	100 mg/kg	.176	15	.200(*)	.910	15	.117
	200 mg/kg	.208	15	.080	.919	15	.176

Table 5 Kolmogorov-Smirnov and Shapiro-Wilk Test for treatments for Tail Immersion method

		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Time	Statistic	df	Sig.	Statistic	df	Sig.
trials	0	.287	12	.007	.815	12	.013
	15	.109	12	.200(*)	.940	12	.785
	30	.155	12	.200(*)	.970	12	.867
	60	.237	12	.061	.830	12	.056
	90	.295	12	.005	.819	12	.021

Table 6 Kolmogorov-Smirnov and Shapiro Test for time for Tail Immersion method

Referring from the performed statistical analysis, Two-way ANOVA, results revealed that there was a significant difference between the effects of the aqueous extract of *M. paradisiaca* L., both in 100 mg/kg and 200 mg/kg, and Morphine ($p<0.05$), indicating a significant difference on the analgesic potential between aqueous extracts and standard morphine, both under the Hot Plate and Tail Immersion Methods.

However, in contrast with the Vehicle, the extract with a dose of 100mg/kg possess no significant difference. On the other hand, the extract with a dose of 200mg/kg does possess significant difference against the vehicle. Thus, only the aqueous extract having a dose of 200mg/kg possesses analgesic activity, higher than the negative control, the Vehicle, but lower than morphine

(I) Treatment (J) Treatment	Mean Difference (I-J)	STD ERROR	Sig.	95% Confidence interval	
				Lower bound	Upper Bound
200 mg/kg Morphine	-3.2120	.54818	.000	-4.8117	-1.6123
Vehicle	2.3087	.54818	.002	.7089	3.9084
100mg/kg	1.4453	.54818	.090	-0.1544	3.0451

Table 7: Scheffe test for the 200 mg/kg extract.

Under the Hot Plate Method, the results revealed a no significant effect on the time interval of the aqueous extract of *M. paradisiaca* L. in 200 mg/kg, and morphine ($p>0.05$), signifying that the aqueous extract, with a dose of 200 mg/kg, and morphine had the ability to exert optimized analgesic potential regardless of time.

However, under the Tail Immersion Method, the results revealed a significant effect on the time interval of the aqueous extract of *M. paradisiaca* L. in 200 mg/kg, and morphine ($p>0.05$), signifying that aqueous extract, with a dose of 200 mg/kg, and morphine had significant difference on the optimum time interval to exert the highest analgesic capability.

CONCLUSION

Using statistic it is concluded that there is a significant difference on the analgesic capability of the extract of *M. paradisiaca* L., both in doses of 100mg/kg and 200mg/kg, and Morphine, using the Hotplate method and Tail Immersion method. There is no statistical difference between the vehicle and the 100mg/kg dose from the extract but not with the 200mg/kg dose.

Using the hotplate method, results revealed a no significant effect on the time interval of the treatment group. The treatment had the ability to exert optimized analgesic effect regardless of optimum time. However, for the tail immersion method, results revealed a significant effect on the time interval of the treatment group. There is a significant difference between the treatment groups on the optimum time interval to exert the highest analgesic capability. Also, using Scheffe post hoc analysis, the results obtained differ significantly between the 100mg/kg and 200mg/kg AMP treatments, therefore signifying that the analgesic effect of the aqueous extracts treatment are dose dependent.

After obtaining the results, the researchers would therefore conclude that the aqueous extracts of the peel of *M. paradisiaca* L. possess potential analgesic activity but not as potent as morphine. The higher dose showed analgesic property better than the lower dose.

RECOMMENDATIONS

The researchers would like to recommend the following: (a) Aside from the peels of the Musa paradisiaca L. we would like to recommend the assessment of the analgesic property of the other parts of the plant. (b) Increasing the concentration of the extract would probably result to the increase analgesic ability. (c) Isolation and purification must be done to improve pharmacologic potential since the extract used in this research we're crude extracts.

BIBLIOGRAPHY

[1] Carr DB, Jacox AK, Chapman CR, Ferrell BR, Fields HL, Heidrich G III, Hester NK, Hill CS Jr., Lipman AG, McGarvey CL, Miaskowski CA, Mulder DS, Payne R, Schechter N, Shapiro BS, Smith RS, Tsou CV, Vecchiarelli L. Acute Pain Management: Operative or Medical Procedures and Trauma. Clinical Practice Guideline. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, US Department of Health and Human Services, 1992. AHCPR Pub. No. 92-0032.

[2] MacIntyre P, on behalf of the Working Party of the Australian and New Zealand College of Anaesthetists. Acute Pain Management: Scientific Evidence, 2nd ed. Melbourne, Australia: Australian and New Zealand College of Anaesthetists, 2005.Available at: http://www.nhmrc.gov.au/publications/synopses/cp104syn.htm

[3] Veilleux, C. and King, S. (1993). A*n introduction to ethnobotany, shaman pharmaceuticals.* New York: Viking Penguin Books. pp1-2.

[4] Momin, A. (1987). Role of indigenous medicine in primary health care. 1st International seminar on Unani medicine. New Delhi, pp 54.

[5] Quisumbing, E. (1978). *Medicinal plants of the Philippines*. Quezon City: JMC Press, INC.

[6] Bannerman, R. H. (1982). World Health Forum 3(1), 8-26,

[7] Fansworth, H. R., Akerele O. (1982). Bulletin of the WHO 03 (6) 965-982,

[8] Sanyal, A. K., Pandey, B. L. and Goel, R. K. J. (1982). Ethnopharmacol. 5, 79,

[9] Sanyal, A.K., Das, P.K., Sinha, S., & Sinha, Y.K, (1961). Banana and gastricsecretion. *J Pharm Pharmacol*;**13**:318-9.

[10] Sanyal, A.K., Gupta, K.K., & Chawdhury, N.K. (1964). Studies of peptic ulceration Part I: Role of banana in phenylbutazone induced ulcers. *Arch Int Pharmacodyn.* ;**149**:393-400.

[11] Sanyal, A.K., Gupta, K.K., Chowdhury, N.K. (1963). Banana and gastric secretion. *J Pharm Pharmacol*;**15**:283-4.

[12] Sanyal, A.K., Banerjee, C.R. & Das, P.K. (1965). Studies on peptic ulceration. Part II : Role of banana in restraint and prednisolone induced ulcer in albino rats, Arch. Int. Pharmacodyn. Ther., Vol. 155

[13] Gurumaa, A. (2008). Go Banana: Banana Guide benefit and Nutrition facts. Retrieved from http://www.gurumaa.com/health-go-bananas.php

[14] Hood, A. M., and Lowbury, E. J. L. (1954). Nature and Land. 173, 402-3,

[15] Jain, S. A. and Sharma B. A. A. (1967). Planta Medica 17, 99-100,

[16] Goel, R.K., Sairam, K. (2002). Anti-ulcer drugs from indigenous sources with emphasis on Musa sapientum, Tamrabhasma, Asparagus racemosus and Zingiber officinale; *Indian Journal of Pharmacology*;34: pp 100-110.

[17] P.K.Agarwal, A.Singh, K.Gaurav, Shalini Goel, H.D.Khanna and R.K.Goel. (2009). Evaluation of wound healing activity of extracts of plantain banana (Musa sapientum var. paradisiaca) in rats; *Indian Journal Exp Biol*; 47: pp 32-40.

[18] Kumar M. M, Joshi M. C, Prabah T., Dorabubu M. and Goel R. K. (2005). Effect of plantain banana on gastric ulceration in NIDDM rats: Role of gastric mucosal glycoproteins, cell proliferation, antioxidants and free radicals: *Indian Journal of Experimental Biology*, 44, April 2006, pp. 292-299

[19] Tarafdar A, Bhattacarya S, Pandey J.N and Biswas M. (2011) thin layer chromatographic profiling and evaluation of analgesic activity of *Musa paradisiaca* leaf extracts in mice. *Pharmacologyonline* 1: 1260-1265 (2011)

[20] Kumar et al (2012) Phytoconstituents and Pharmacological activities of Musa paradisiaca Linn. Asean Journal of Biochemical and Pharmaceutical Research *Issue 4 (Vol. 2) 2012*

[21] G.H. Rabbani, T. Teka, B. Zaman, M. Majid N Khatun & G.J.Fuchs., *Gastroenterol*., 2001,121, 554.

[22] Fagbemi, J. F., Ugoji E., Adenipekun T,. and Adelowotan O. (2009). Evaluation of the antimicrobial properties of unripe banana (*Musa sapientum* l.), Lemon grass (*Cymbopogon citrates* S.) and turmeric (*Curcuma longa* L.) on pathogens. *African Journal of Biotechnology*, 8 (7), pp. 1176-1182.

[23] Eriyamremu G. E., Asagba S. O., Osagie V. E., Ojeaburu S. I. and Lolodi O. (2007). Phospolipid Profile of the Stomach and Duodenum of Normal Rabbit Fed with Suppliments of Unripe Paw Paw (*Carica papaya)* and Unripe Plantain (*Musa sapientum)* Extract. *Journal of Applied Sciences*, 7 (22): 3536-3541.

[24] Ingale, Suvarna P., Ingale, Pramod L., & Joshi, Anagha M. (2009). To study analgesic activity of stem of *Musa sapientum* Linn. *Journal of Pharmacy*. 2(9), 1381-1382

[25] Eddy, N.B. and Leimbach, D. (1953). Synthetic analgesics. II. Dithienylbutenyl- and dithienylbutymamines. *J Phrm Exp Ther*, 107:385-393

[26] Vogel, G.H., Hock, J.F., Maas, J. and Mayer, D. (2006) *Drug discovery and evaluation: safety and pharmacokinetic assays*. Springer:Germany. pp 29-30.

[27] Pavia, D.L., Lampman, G.M., and Kriz, G.S. (2002). *Microscale and macroscale techniques in the organic laboratory* (1st ed). United States of America: Brooks/Cole, a division of Thomson Learning, Inc.

[28] Coleman, Douglas L., et al. (1966). *Biology of the laboratory mouse*, 2nd ed. Dover Publications: New York, USA.

[29] Fish, R.E., Brown, M.J., Danneman, P.J., & Karas, A.Z.(2008). *Anesthesia and analgesia in laboratory animals*. USA: Academic Press.

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