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## Development and Evaluation of Antipyretic and Antinociceptive Activity of Polyherbal Formulation Containing Some Indigenous Medicinal Plants

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**Abstract:** In the present study, it was envisaged to prepare three polyherbal formulations (F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub>) containing leaves of *Solanum xanthocarpum* and *Andrographis paniculata*, rhizomes of *Curcuma longa* and stem of *Tinospora cordifolia* in varying ratio and evaluating the polyherbal formulations for the antipyretic and antinociceptive activities. The antipyretic activity of methanol extracts (MF<sub>1</sub>, MF<sub>2</sub> and MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub>, AF<sub>2</sub> and AF<sub>3</sub>) of polyherbal formulation were studied in Brewer's yeast induced pyrexia in mice. The antinociceptive activity of methanol and aqueous extracts of polyherbal formulation were studied using Eddy's hot plate method and tail flick method in mice. The polyherbal formulation of all extracts showed significant reduction in the elevated body temperature of rat which was compared with standard paracetamol. The extract of polyherbal formulation produced significant increase in the reaction time by Eddy's hot plate method and tail flick method in mice which was compared with standard morphine sulphate. From these results it may be concluded that AF<sub>1</sub> formulation demonstrated maximum significant antipyretic and antinociceptive activities that might be due to combined effect of active constituents present in all plant material.

**Key words:** Polyherbal formulation, antipyretic activity, antinociceptive activity, brewer's yeast

### INTRODUCTION

Herbal Medicine is the oldest form of healthcare known to mankind. In traditional medicines, various herbal preparations are being used for treating rise in body temperature (Mounissamy *et al.*, 2008) and relief of pain (Gupta *et al.*, 2007). Now polyherbal formulation are becoming more popular because of simplified treatment regimens, improved clinical effectiveness, enhanced patient adherence and reduced administrative costs. Therefore we planned to prepare polyherbal formulation containing leaves of *Solanum xanthocarpum* and *Andrographis paniculata*, rhizomes of *Curcuma longa* and stem of *Tinospora cordifolia*. The leaves of *S. xanthocarpum* are used in fever, expectorant in cough and asthma (Kulsar, 1976). This plant has been reported beneficial in treatment of asthma and chronic bronchitis (Gunselvi *et al.*, 2010). The leaves and root extracts of *A. paniculata* exhibits antimalarial, anti-hepatic, analgesic and antipyretic properties, besides its general use as an immunostimulant agent (Lin *et al.*, 2009; Puri *et al.*, 1993). The rhizomes of *C. longa* used as anti-inflammatory, analgesic, antioxidant, hepatoprotective and antimicrobial properties, in addition to its use in cardiovascular disease and

gastrointestinal disorders (Neha *et al.*, 2009). The bitter principles present in *T. cordifolia* show antiperiodic, antispasmodic, anti-inflammatory and antipyretic properties (Panchabhai *et al.*, 2008; Vedavathy and Rao, 1991). This plant is used in Ayurvedic to improve the immune system and body resistance against infections (Prince *et al.*, 1998). In the different formulations used by different herbal practitioners, these plants were the chief ingredients to treat pyrexia, inflammation and related pain. These plants were reported having flavonoids, triterpenoids, polyphenolic compounds, glycosides etc. (Bhatt, 2011; Pachaly and Schneider, 1981; Qudrat-I-Khuda *et al.*, 1964; Singh *et al.*, 2007). Flavonoids and polyphenolic compounds are known for their biological efficacy such as antipyretic, anti-hepatotoxic, analgesic and anti-inflammatory (Hajare *et al.*, 2000; Singh and Singh, 2010).

However, there were no scientific evaluations records found based on experimental trial on rats about the antipyretic and antinociceptive efficacy of this medicinal preparation. So here we planned to make such polyherbal formulation which produce synergistic effect against antipyretic and analgesic along with increasing the immune system of body. Therefore, this study was

undertaken to develop and evaluate the antipyretic and analgesic activity of three different polyherbal formulations containing leaves of *S. xanthocarpum* and *A. paniculata*, rhizomes of *C. longa* and stem of *T. cordifolia* in varying ratio.

## MATERIALS AND METHODS

**Plant material:** The leaves of *Solanum xanthocarpum* and *Andrographis paniculata*, rhizomes of *Curcuma longa* and stem of *Tinospora cordifolia* were collected from the out field of Bhopal city, Madhya Pradesh, India in August 2010. The species were identified by the local people during the time of collection and later on authentication was made by Dr. P. Jayaraman, Botanist, Plant Anatomy Research Centre (PARC), Chennai, India.

The plant parts were washed with distilled water to remove dirt and soil and shade dried. The dried materials were powdered and passed through a 10-mesh sieve. The three formulations (F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub>) were made by mixing different ratio of plant powdered materials. The composition of different polyherbal formulation was given in Table 1.

### Preparation of extracts

**Preparation of methanol extract:** All the three formulations were extracted separately with methanol in a Soxhlet apparatus. The extracts were filtered and concentrated by distilling off the solvents and evaporated to dryness using water bath to get crude methanol extract.

**Preparation of decoction:** Twenty grams of mixture of each formulation with 150 mL of distilled water were macerated at ambient temperature for 24 h. After 24 h the drug macerate was boiled for 45 min and filtered through muslin cloth to get a decoction. The volume of the decoction was adjusted such that 20 g of mixture gave 50 mL of the decoction.

**Animals:** Swiss albino mice having weight 20-30 g were maintained under standard conditions of temperature (23±1°C), relative humidity (55±10%) and 12 h/12 h light/dark cycle and fed with a standard pellet diet with water *ad libitum*. They were housed in standard polypropylene cages with wire mesh top. All studies were

carried out using six animals in each group. The project proposal was approved by the Institutional Animal Ethical Committee (1349/ac/10/CPCSEA).

**Acute oral toxicity study:** Acute oral toxicity was performed by following OECD guideline-420 fixed dose procedure for methanol and aqueous extract of polyherbal formulations and it was found that dose increasing up to 2000 mg kg<sup>-1</sup> body wt. shown no toxicity or mortality in experimental rats. The LD<sub>50</sub> of the methanol and aqueous extract as per OECD guidelines-420 is greater than 2000 mg kg<sup>-1</sup> (Ecobichon, 1997).

**Antipyretic studies:** The procedure described by Al-Ghamdi (2001) was adopted for this study. The body temperature of each albino Wistar mice was recorded by measuring rectal temperature at predetermined intervals. Albino Wistar mice were fasted overnight with water *ad libitum* before the experiments. Pyrexia was induced by subcutaneously injecting 20% (w/v) brewer's yeast suspension (10 mL kg<sup>-1</sup>) into the animal's dorsum region. The rectal temperature of each mice was again recorded after 24 h of yeast administration. Mice that did not show a minimum increase of 0.5°C in temperature 24 h after yeast injection were discarded. Forty eight selected mice were grouped into eight and immediately treated as follows: group I received normal saline, group II received 10 mg kg<sup>-1</sup> paracetamol, group III to group V received methanol extract (MF<sub>1</sub> to MF<sub>3</sub>) 100 mg kg<sup>-1</sup> i.p., while group VI to group VIII received decoction (AF<sub>1</sub> to AF<sub>3</sub>) 20 mL kg<sup>-1</sup> body weight orally. Rectal temperature of all the mice was then recorded by inserting digital thermometer into the rectum of each mice at 30 min (Woode *et al.*, 2009).

### Antinociceptive activity

**Hot plate method:** The animals were divided into eight groups with six mice in each group. Group I animals served as control, animals of Group II received Morphine sulphate at 5 mg kg<sup>-1</sup> body weight i.p., while animals of group III to group V received methanol extract (MF<sub>1</sub> to MF<sub>3</sub>) 100 mg kg<sup>-1</sup> i.p., while group VI to group VIII received decoction (AF<sub>1</sub> to AF<sub>3</sub>) 20 mL kg<sup>-1</sup> body weight orally. The animals were placed on Eddy's hot plate kept at a temperature of 55±0.5°C. A cut off period of 15 sec was observed to avoid damage to the paw. Reaction time was recorded when animals licked their fore or hind paws, or jumped prior to and 0, 30, 60 and 90 min after administration of the samples (Zakaria *et al.*, 2006; Franzotti *et al.*, 2001).

**Hot tail flick method:** The animals were divided into eight groups of six animals each. Group I served as control,

Table 1: Composition of polyherbal formulation containing plant material

Formulations	Plants (g)			
	<i>C. longa</i>	<i>T. cordifolia</i>	<i>A. paniculata</i>	<i>S. xanthocarpum</i>
F <sub>1</sub>	10	15	15	20
F <sub>2</sub>	10	15	20	15
F <sub>3</sub>	20	10	15	15

Group II served as standard and were injected Morphine sulphate (5 mg kg<sup>-1</sup>) intraperitoneally, group III to group V received methanol extract (MF<sub>1</sub> to MF<sub>2</sub>) 100 mg kg<sup>-1</sup> i.p., while group VI to group VIII received decoction (AF<sub>1</sub> to AF<sub>3</sub>) 20 mL kg<sup>-1</sup> b.wt. orally After treatment of mice, the tip of tail was dipped up to 5 cm into hot water maintained at 50±0.7°C and tail flick responses were recorded. The same experiment was repeated after 30, 60, 90 and 120 min. Cut off time of 10 sec was maintained to avoid damage to the tail for all groups (Sanmugapriya and Venkataraman, 2010).

**Statistical analysis:** The results are expressed as Mean±SEM of six independent experiments. Statistical significance between group was evaluated by one-way Analysis of Variance (ANOVA) followed by Dunnett's test. A p<0.05 value was considered as statistically significant.

**RESULTS**

**Antipyretic activity:** Antipyretic activity of methanolic and aqueous extracts of polyherbal formulation was determined in pyrexia induced model. It was evident from the Table 2, after 1 h administration of extracts, the methanol extracts (MF<sub>1</sub> and MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub>, AF<sub>2</sub> and AF<sub>3</sub>) of polyherbal formulation produced significant (p<0.05) antipyretic activity, while methanol extracts (MF<sub>2</sub>) showed significant (p<0.05) antipyretic activity at 1.5 h. The aqueous extract AF<sub>1</sub> of polyherbal

formulation showed maximum decrease in body temperature (35.24±0.17), exhibited highest antipyretic activity. Results were comparable with the standard drug, paracetamol, at 10 mg mL<sup>-1</sup> concentration. The aqueous extract of polyherbal formulation showed more potent activity than methanol extract.

**Hot plate method:** The result of hot plate test indicated that methanol extracts (MF<sub>1</sub> to MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub> to AF<sub>3</sub>) produced significant (p<0.05) increase in reaction time at 0.5, 1 and 1.5 h as comparable to the reference drug morphine sulphate (5 mg kg<sup>-1</sup>; i.p.) which is showed in Table 3. The methanol extracts (MF<sub>1</sub> to MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub> to AF<sub>3</sub>) showed dose dependent increase in the reaction time at 1.5 h. The aqueous extract AF<sub>1</sub> of polyherbal formulation showed maximum increase in reaction time (12.96±0.47 sec), exhibited highest antinociceptive activity.

**Hot tail flick method:** The tail withdrawal reflex time following administration of the methanol extracts (MF<sub>1</sub> to MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub> to AF<sub>3</sub>) of polyherbal formulation was found to increase from 0.5 to 1.5 h. The results obtained from hot tail flick experiments are shown in Table 4, in this model, administration of methanol and aqueous extract of polyherbal formulation showed significant (p<0.05) protection against the pain induction. The methanol extracts (MF<sub>1</sub> to MF<sub>3</sub>) and aqueous extracts (AF<sub>1</sub> to AF<sub>3</sub>) showed dose dependent increase in the reaction time at 1.5 h. The aqueous extract AF<sub>1</sub> of

Table 2: Antipyretic effect of methanol and aqueous extracts of polyherbal formulation

Treatment	Dose	Rectal temperature (°C)				
		0.0 h	0.5 h	1.0 h	1.5 h	2.0 h
Control	-	38.36±0.14	38.23±0.15	38.43±0.12	38.10±0.16	37.62±0.54
Paracetamol	10 mg kg <sup>-1</sup>	38.09±0.21	37.52±0.31*	36.95±0.18*	35.56±0.20*	35.32±0.14*
MF <sub>1</sub>	100 mg kg <sup>-1</sup>	38.31±0.15	38.29±0.11	37.58±0.17*	36.05±0.15*	35.81±0.17*
MF <sub>2</sub>	100 mg kg <sup>-1</sup>	38.38±0.08	38.31±0.10	38.02±0.15	37.68±0.10*	36.37±0.12*
MF <sub>3</sub>	100 mg kg <sup>-1</sup>	38.27±0.16	38.19±0.16	37.71±0.25*	36.15±0.32*	35.96±0.28*
AF <sub>1</sub>	20 mL kg <sup>-1</sup>	38.51±0.15	38.52±0.11	37.25±0.17*	35.91±0.15*	35.24±0.17*
AF <sub>2</sub>	20 mL kg <sup>-1</sup>	38.24±0.09	38.28±0.10	37.98±0.15*	36.30±0.10*	36.01±0.12*
AF <sub>3</sub>	20 mL kg <sup>-1</sup>	38.22±0.19	38.23±0.16	37.68±0.25*	36.25±0.32*	35.52±0.28*

Values are expressed as Mean±SEM, n = 6 in each group, \*p<0.05 compared to control group, MF: Methanolic extract, AF: Aqueous extract

Table 3: Analgesic effect of methanol and aqueous extracts of polyherbal formulation by hot plate method

Treatment	Dose	Licked time recorded in second			
		0.0 h	0.5 h	1.0 h	1.5 h
Control	-	2.21±0.20	2.26±0.20	2.39±0.20	2.19±0.25
Standard	10 mg kg <sup>-1</sup>	2.23±0.32	5.80±0.46*	9.40±0.35*	14.84±0.59*
MF <sub>1</sub>	100 mg kg <sup>-1</sup>	2.23±0.25	3.43±0.16*	5.65±0.31*	6.17±0.36*
MF <sub>2</sub>	100 mg kg <sup>-1</sup>	2.3±0.23	3.89±0.24*	6.6±0.39*	8.14±0.23*
MF <sub>3</sub>	100 mg kg <sup>-1</sup>	2.14±0.26	3.41±0.37*	6.03±0.33*	10.16±0.59*
AF <sub>1</sub>	20 mL kg <sup>-1</sup>	2.16±0.27	4.61±0.18*	9.58±0.16*	12.96±0.47*
AF <sub>2</sub>	20 mL kg <sup>-1</sup>	2.32±0.20	2.89±0.15	4.89±0.25*	5.20±0.34*
AF <sub>3</sub>	20 mL kg <sup>-1</sup>	2.17±0.25	3.09±0.18	5.08±0.29*	7.41±0.29*

Values are expressed as Mean±SEM, n = 6 in each group, \*p<0.05 compared to control group, MF: Methanolic extract, AF: Aqueous extract

Table 4: Analgesic effect of methanol and aqueous extracts of polyherbal formulation by tail flick method

Treatment	Dose	Tail flick response in second			
		0.0 h	0.5 h	1.0 h	1.5 h
Control	-	1.98±0.17	1.85±0.20	1.94±0.20	1.91±0.12
Standard	10 mg kg <sup>-1</sup>	1.97±0.27	5.06±0.28*	7.74±0.35*	11.38±0.55*
MF <sub>1</sub>	100 mg kg <sup>-1</sup>	1.83±0.20	3.33±0.06*	6.01±0.22*	8.51±30*
MF <sub>2</sub>	100 mg kg <sup>-1</sup>	2.07±0.16	2.56±0.16*	3.81±0.19*	4.47±0.20*
MF <sub>3</sub>	100 mg kg <sup>-1</sup>	1.89±0.18	2.68±0.22*	4.82±0.22*	6.33±0.35*
AF <sub>1</sub>	20 mL kg <sup>-1</sup>	1.92±0.20	3.85±0.22*	6.62±0.24*	9.05±0.25*
AF <sub>2</sub>	20 mL kg <sup>-1</sup>	1.90±0.22	2.96±0.02*	4.01±0.15*	6.39±0.38*
AF <sub>3</sub>	20 mL kg <sup>-1</sup>	1.83±0.19	3.49±0.18*	5.22±0.24*	8.46±0.35*

Values are expressed as Mean±SEM, n = 6 in each group, \*p<0.05 compared to control group, MF: Methanolic extract, AF: Aqueous extract

polyherbal formulation showed maximum increase in reaction time (9.05±0.25 sec), exhibited highest antinociceptive activity. The formulation AF<sub>1</sub> showed maximum activity as compared to other formulations.

### DISCUSSION

The aqueous extract of polyherbal formulation showed more potent antipyretic and antinociceptive activities than methanol extract of polyherbal formulation. The aqueous extract of first polyherbal formulation (AF<sub>1</sub>) showed maximum significant antipyretic and antinociceptive activities compared with all other methanol and aqueous extract.

Antipyretic are the agents, which reduce the elevated body temperature. Regulation of body temperature requires a delicate balance between production and loss of heat and the hypothalamus regulates the set point at which body temperature is maintained (Akindele and Adeyemi, 2007). In fever this set point elevates and a drug like paracetamol does not influence body temperature when it is elevated by the factors such as exercise or increase in ambient temperature. Yeast induced fever is called pathogenic fever. Its etiology includes production of prostaglandins, which set the thermoregulatory center at a lower temperature (Goodman and Gilman, 1996). The present results show that polyherbal formulation possesses a significant antipyretic effect in yeast-provoked elevation of body temperature in mice and its effect is comparable to that of paracetamol (standard drug). So inhibition of prostaglandin synthesis could be the possible mechanism of antipyretic action as that of paracetamol. Also, there are several mediators or multiprocesses underlining the pathogenesis of fever. Inhibition of any of these mediators may bring about antipyresis (Danquah *et al.*, 2011).

The hot-plate and tail-flick tests are useful in elucidating centrally mediated antinociceptive responses, which focuses mainly on changes above the spinal cord level. The tail flick and hot plate methods are further

distinguished by their tendency to respond to the pain stimuli conducting through neuronal pathways as the tail flick mediates a spinal reflex to nociceptive stimuli, while the hot plate involves higher brain functions and is a supraspinally organized response morphine and related opioid analgesic drugs exert their antinociceptive effects by interacting with different opioid receptors both at spinal and supraspinal sites. From the result it has been observed that narcotic analgesic drug, morphine (5 mg kg<sup>-1</sup>, i.p.) exhibited significant antinociceptive effects in the hot plate (supra spinal) as well as in the tail flick (spinal) tests. The significant increase in pain threshold produced by the methanol and aqueous extracts of polyherbal formulation in these models suggests involvement of central pain pathways (Kumar and Rajani, 2011; Okokon *et al.*, 2008). The antinociceptive effect produced by the extract may be via central mechanisms involving these receptor systems or via peripheral mechanisms involved in the inhibition of prostaglandins, leucotrienes and other endogenous substances that are key players in pain (Srinivasan *et al.*, 2003). The ability of methanol and aqueous extracts of polyherbal formulation inhibits prostaglandin synthesis and other mediators and it produces antinociceptive activity. However, the mechanism behind the central antinociceptive action of the extracts in the hot plate and tail flick tests is not completely understood and may need further investigation.

### CONCLUSIONS

In conclusion, present findings demonstrated that the methanol and aqueous extracts of polyherbal formulation has the favorable antipyretic and antinociceptive activities, which are involved in possible inhibition of the central synthesis of prostaglandins. However, further studies are necessary to fully elucidate the mechanism of action of the polyherbal formulation. AF<sub>1</sub> formulation demonstrated maximum significant antipyretic and antinociceptive activities that might be due to combined

effect of active constituents present in all plant material. Further investigations are in progress in our laboratory for fully development of this aqueous polyherbal formulation, so that it can be prepare easily in home when required.

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#### REFERENCES

- Akindele, A.J. and O.O. Adeyemi, 2007. Antipyretic activity of *Byrsocarpus coccineus* Schum and Thonn. (Connaraceae). Int. J. Pharmacol., 3: 357-361.
- Al-Ghamdi, M.S., 2001. The anti-inflammatory, analgesic and antipyretic activity of *Nigella sativa*. J. Ethnopharmacol., 76: 45-48.
- Bhatt, B., 2011. Chemical constituents of *Solanum xanthocarpum*. J. Chem. Pharm. Res., 3: 176-181.
- Danquah, C.A., E. Woode, E.B. Gyasi, M. Duwiejua and C. Ansah, 2011. Anti-inflammatory and antipyretic effects of an ethanolic extract of *Capparis erythrocarpos* Isert roots. Res. J. Med. Plant, 5: 158-168.
- Ecobichon, D.J., 1997. Fixed Dose Procedure, Guidline 420: The Basis of Toxicity Testing. 2nd Edn., CRC Press, New York, Page: 43.
- Franzotti, E.M., C.V.F. Santos, H.M.S.L. Rodrigues, R.H.V. Mourao, M.R. Andrade and A.R. Antonioli, 2001. Anti-inflammatory, analgesic activity and acute toxicity of *Sida cordifolia* L. (Malva-branca). J. Ethnopharmacol., 72: 273-277.
- Goodman, L.S. and A.G. Gilman, 1996. The Pharmacological Basis of Therapeutics. 19th Edn., McGraw-Hill, New York, pp: 959-975.
- Gunaselvi, G., V. Kulasekaran and V. Gopal, 2010. Anthelmintic Activity of the extracts of *Solanum xanthocarpum* Schrad and Wendl fruits (Solanaceae). Int. J. PharmTech Res., 2: 1772-1774.
- Gupta, M., U.K. Mazumdar and P. Gomathi, 2007. Antiinflammatory and antinociceptive effects of *Galega purpurea* root. Int. J. Pharmacol., 3: 210-218.
- Hajare, S.W., C. Suresh, S.K. Tandan, J. Sarma, J.L. La and A.G. Telang, 2000. Analgesic and antipyretic activities of *Dalbergia sissoo* leaves. Indian J. Pharmacol., 32: 357-360.
- Kulcsar, G.J., 1976. The effect of solasodine on the body temperature. Arzneimittelforschung, 26: 55-57.
- Kumar, Y.R. and G.P. Rajani, 2011. Analgesic and anti-ulcer activities of ethanol and aqueous extracts of root of *Bauhinia variegata* Linn. Int. J. Pharmacol., 7: 616-622.
- Lin, F.L., S.J. Wu, S.C. Lee and L.T. Ng, 2009. Antioxidant, antioedema and analgesic activities of andrographis paniculata extracts and their active constituent andrographolide. Phytother. Res., 23: 958-964.
- Mounnissamy, V.M., S. Kavimani, V. Balu and S.D. Quine, 2008. Antipyretic activity of ethanol extract of *Cansjera rheedii* J. Gmelin (Opiliaceae). J. Pharmacol. Toxicol., 3: 378-381.
- Neha, S., G.D. Ranvir and C.R. Jangade, 2009. Analgesic and antipyretic activities of *Curcuma longa rhizome* extracts in Wister Rats. Vet. World, 2: 304-306.
- Okokon, J.E., B.S. Antia and E. Umoh, 2008. Analgesic and anti-inflammatory effects of ethanolic root extract of *Hippocratea africana*. Int. J. Pharmacol., 4: 51-55.
- Pachaly, P. and C. Schneider, 1981. Alkaloids from *Tinospora cordifolia* Miers. Arch. Pharmacol., 314: 251-256.
- Panchabhai, T.S., U.P. Kulkarni and N.N. Rege, 2008. Validation of therapeutic claims of *Tinospora cordifolia*: A review. Phytother. Res., 22: 425-441.
- Prince, P.S.M., V.P. Menon and G. Gunasekaran, 1998. Hypolipidaemic action of *Tinospora cordifolia* roots in alloxan diabetic rats. J. Ethnopharmacol., 64: 53-57.
- Puri, A., R. Saxena, R.P. Saxena, K.C. Saxena, V. Srivastav and J.S. Tandon, 1993. Immuriostimulant agents from *Andrographis paniculata*. J. Nat. Prod., 58: 995-999.
- Qudrat-I-Khuda, M., A. Khaleque and N. Ray, 1964. *Tinospora cordifolia* L. constituents of the plant fresh from the field. Sci. Res., 1: 177-183.
- Sanmugapriya, E. and S. Venkataraman, 2010. Antinociceptive and antipyretic effects of *Strychnos potatorum* Linn. seeds on experimental rats. Int. J. Pharmacol., 6: 681-685.
- Singh, O.M. and T.P. Singh, 2010. Phytochemistry of *Solanum xanthocarpum*: An amazing traditional healer. J. Sci. Ind. Res., 69: 732-740.
- Singh, P.K., S. Roy and S. Dey, 2007. Protective activity of andrographolide and arabinogalactan proteins from *Andrographis paniculata* Nees. against ethanol-induced toxicity in mice. J. Ethnopharmacol., 111: 13-21.
- Srinivasan, K., S. Muruganandan, J. Lal, S. Chandra, S.K. Tandan, V. Raviprakash and D. Kumar, 2003. Antinociceptive and antipyretic activities of *Pongamia pinnata* leaves. Phytother. Res., 17: 259-264.

- Vedavathy, S. and K.N. Rao, 1991. Antipyretic activity of six indigenous medicinal plants of Tirumala hills. *J. Ethnopharmacol.*, 33: 193-196.
- Woode, E., R.A. Poku, G.K. Ainooson, E. Boakye-Gyasi, W.K.M. Abotsi, T.L. Mensah and A.K. Amoh-Barimah, 2009. An evaluation of the anti-inflammatory, antipyretic and antinociceptive effects of *Ficus exasperata* (Vahl) leaf extract. *J. Pharmacol. Toxicol.*, 4: 138-151.
- Zakaria, Z.A., R.N.S.R.M. Nor, M.R. Sulaiman, Z.D.F.A. Ghani, G.H. Kumar and C.A. Fatimah, 2006. Antinociceptive and anti-inflammatory properties of *Melastoma malabathricum* leaves chloroform extract in experimental animals. *J. Pharmacol. Toxicol.*, 1: 337-345.