Ind. J. Pharm. Edu. Res., 2024; 58(1):162-171.
https://www.ijper.org

Original Article

Anti-Asthmatic and Immunomodulatory Effect of *Actinidia deliciosa* Fruit on Swiss Albino Mice

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ABSTRACT

Aim: The aim of the current research is the evaluation of immunomodulatory and anti-asthmatic activity of *Actinidia deliciosa* on Swiss albino mice by using a number of experimental models. **Materials and Methods:** The immunomodulatory and anti-asthmatic activity of *Actinidia deliciosa* in Swiss albino mice was evaluate by using models like delayed type hypersensitivity, neutrophil adhesion test, milk induced neutrophil leucocytes in mice, clonidine induced catalepsy activity in mice, clonidine induced mast cell degranulation method. Microscopic and histopathology images also taken during the experiment for better analysis of the outcomes. **Results:** The result obtained after performing the various models were observed that ethanolic extract of fruit of *Actinidia deliciosa* significantly $^{**}p<0.001$ inhibit delayed type hypersensitivity, helps to increase neutrophil migration towards foreign body which are primary mediators and playsimportant role to fight infections, it also reduces leucocytes and eosinophilia count increased by milk, hence, work as anti-asthmatic agent. It was also found that the *Actinidia deliciosa* fruit extract reduces cataleptic activity of mice and protects mast cells from degranulation. **Conclusion:** The current study findings showed that ethanolic extract of *Actinidia deliciosa* fruits possess immunomodulatory and anti-asthmatic activity by reducing hypersensitivity reactions, increasing neutrophil migration towards antigens, reduces leucocytes and eosinophilia counts, also helps in the reduction of cataleptogenic activity and protects mass cell degranulation.

Keywords: Immunomodulatory, Anti-asthmatic, *Actinidia deliciosa*, Neutrophils, Degranulation.

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Received: 31-10-2022;
Revised: 26-06-2023;
Accepted: 08-10-2023.

INTRODUCTION

Medicinal plant has been source of healing around the world for millennials, and it also maintain contemporary importance for drug discovery. Around 80% of synthetic drugs are derived from medicinal plants.[1]

Since the discovery of new technology and new microscopic world this brings enormous expansion of information about structural, chemical and atomic levels, these leads enhance the range of research and development of herbal drugs.[2]

The Kiwi fruit, *Actinidia deliciosa*, sometimes known as kiwi, has a variety of minerals and phyto-constituents that provide a number of health advantages. According to published research, *Actinidia deliciosa*, which includes vitamins c and folate as well as minerals, carbohydrates, enzymes, proteins, and dietary fiber, confers a variety of pharmacological advantages, which is why kiwis are regarded as superfoods. This superfood has been the subject of several studies to assess its medical and nutraceutical value scientifically, including its anti-hypertensive, hypoglycemic, cardio-protective, and other properties.[3]

The fuzzy brown, edible fruits of this species' cultivars are now widely produced commercially around the world and have become an essential grocery item all year long. Its glossy, deep-green foliage is sometimes cultivated for decorative purposes. Late spring sees the appearance of greenish-white, slightly fragrant blossoms on wood older than a year, although they aren't very spectacular because the foliage usually hides them. Fruits mature in the early fall and have a tartly sweet flavor evocative of a combination of pineapple, strawberry, melon, and banana. They are about the size of slightly flattened chicken eggs. It is necessary to establish both male and female plants in this species in order to ensure adequate pollination and fruiting because it is dioecious (has distinct male and female plants).[4]

Dietary fiber from kiwis contains cell-wall polysaccharides, because they are made up of cellulose, hemicelluloses, and pectic polysaccharides. The hemicelluloses are made up of xyloglucan and xylan, pectic polysaccharides (arabino)-galactan side chains.

DOI: 10.5530/ijper.58.1.17

In vitro contact to stomach and small intestine digestion had no impact on the ratio's cellulose of kiwifruit.[5]

The species of Actinidia are perennial in nature, it is a climbing plant in which vines with young shoots grows up to a height of 9 m. Its young shoots are having very small hairs on 8 and their leaves are petiole and heart shaped.[6]

In the spring, flowers start to bloom about 60 days after the bud breaks. Kiwi produce flowers with cream-colored petals that eventually become yellow with age. Kiwi plants of both species only have blooms, either female or either male. The creamy blooms are around 5 cm in diameter, feature five petals and sepals, many stamens, and stigma position is radially.[7]

MATERIALS AND METHODS

Material used

Levamisole (Khandelwal laboratories), Methotrexate (IPCA Laboratories), Dexamethasone (Cadila Pharmaceuticals), Clonidine (Torrent Pharmaceuticals), Chlorpheniramine (Supriya lifesciences), L-dopa (Pfizer) and Sodium chromoglycate (Astra Zeneca pharma).

Extraction process of plant part

Ethanolic extract has been prepared by using hot extraction process. Absolute ethanol as a solvent was used to extract the dried and powdered material of plant fruit (commonly known as kiwi fruit). The 50 g of dry fruit powder was extracted with absolute ethanol by using the soxhlet apparatus. Residue solvent was evaporated at 50°C on hot water bath and the extract was dried and concentrates. This dried crude concentrate extract was weighed and stored in refrigerator at 4°C until needed for further practical use.[8]

Experimental animals

In this experiment albino mice of 15-25 g of body weight were used. The IAEC (The Institutional Animal Ethics Committee) of NIET, Pharmacy Institute accepted this animal experimental protocol (IAEC/NIET/2022/01/17). All the Swiss albino mice well maintained in cages for 90 days in the animal House of the institute. They were kept in polypropylene cages at the temperature of 25±2°C and at relative humidity of 45-70%, so about the experimental procedure they were provided unlimited water and a regular animal palate diet. Anesthesia was given before the mice were sacrificed before carried out sacrifice procedure of mice. The registration number is (1845/PO/Re/S/16/CPCSEA).

Delayed Type Hypersensitivity (DTH)

This model was used for calculating cell mediated immune response. The DTH reaction has two phases, the afferent phase and efferent phase. In the affluent phase (day 0) mice were given subcutaneous injection having ovalbumin as antigen. The efferent phase takes place after sensitization day and lasts for 5-11 days. The DTH response is evaluated 24 hr post challenge.

Group One is the control negative group which is non sensitized group two is the control positive which is OVA sensitized group three is the standard group and group four and five are the ethanolic extract *of Actinidia deliciosa* at low dose 50mg/kg and high dose 100mg/kg. Except for normal saline group all the group were treated with 10 µg ovalbumin + alum 200 µg as adjuvant s.c. On day 0 the food pads of all mice were subcutaneously challenged with ova. Then standard and test drug were given post challenge upto 6 to10 days the footpaths of all the mice were subcutaneously challenge with ova+alum 1 hr post the last administration of drug. Then after measuring the footpath swelling by caliper before and next day after of ova challenge. Histopathology of foot pad of mice were done for calculation and result purpose. The inflammation the inflammatory reaction of mice foot pads was measured by histological analysis.[6]

Neutrophil adhesion test

Neutrophils are components of immune system response which contributes to the removal of foreign material by identification and movement towards the foreign body direction, involvement of the process of phagocytosis, and destruction of the foreign material. Neutrophil cell adhesion is one of the first reactions to both immunological and physical damage. The neutrophil adhesion test measured neutrophil cell adherence in blood sample from various groups by treating them with nylon fibers to which neutrophils attach.

In the present experimental procedure neutrophil adhesion of control positive group control negative group and test group all compared with standard drug. This comparison showed that all extracts have more rising neutrophil and its adhesion as compared to Disease Control. Standard group showed major rise in neutrophil adhesion process on comparison of Disease Control group, test group also showed their rise in neutrophil adhesion but less than standard group.[9]

Anti-asthmatic activity

Milk induce leucocytes and eosinophilia in mice

During the case of asthmatic inflammation, leukocytes emit inflammation mediators such as cytokines, histamine, and some basic proteins, which promotes to the continuous inflammation. Eosinophils are most common inflammatory cells in asthmatic patients' bronchial biopsies, and it is possible to see it in the sub mucosal layers and epithelial layers. A significant rise in the number of eosinophils peripherals in nature. Eosinophilia is defined as rise in around 4% of total leukocytes. In asthmatic individuals, the eosinophil count rises.

All the mice divided into 5 group containing 6 mice in every group. All the mice were given anesthesia and blood was taken out

from vein of cervical area, and they are calculated for their Total Cell Count (TLC) and Differential Cell Count (DLC). The total leukocytosis and eosinophilia count were done for each group prior of drug administration and 24 hr later drug administration the difference in total leukocyte count and differential leukocyte count before and after 24 hr of drug administration was calculated.[10]

Clonidine induced catalepsy in mice

In catalepsy, animal retains an enforced position for an extended period of time prior to resuming normal posture. Clonidine is a secondary medicine that blocks dopamine transmission or enhance neurotransmitter release in the brain.

Clonidine causes mast cells to release histamine. Histamine in the brain does have a role in the formation of neurogenic motor symptoms in catalepsy. As a result, it has been proposed that Clonidine's cataleptic impact in mice is mediate by histamine (through H1 receptors), produced from brain mast cells on responsive to Clonidine activation of α2 adrenoreceptors.

Bar test was used in the experiment to study the effect of *Actinidia deliciosa* test drug 5 groups having 6 animals in each group were use in the experiment.

The paws of mice lay down on straight line horizontal bar (which is having diameter of 1 cm and 3 cm over the table). The time span of retention of paws of mice to the bar was observed (for each mouse) and the time span of catalepsy was measured at different intervals of time.[11]

Clonidine-induced Mast Cell Degranulation in mice

All mice split up into 5 groups having 5 mice in each group. The drug medication was followed for 3 days. One Group is vehicle treated, Group II clonidine treated, work as positive control, Group III receive sodium chromoglycate and group IV and V receive low dose and high dose of ethanolic extract of *Actinidia deliciosa* respectively. On 4th day after the last dose theanimals were injected with 2 mL saline in peritoneal cavity. On gently massage, peritoneal fluid collected from peritoneal cavity after 5 min, and transferred into test tube having 7RPMI- 1640 buffer medium (pH 7.1- 7.2). Then centrifuge to 300-500 rpm, then mast cell pellets were washed with buffer medium, then after discard the supernatant. The mast cells were challenged with clonidine (with 80mcg/mL) then incubate at 35-37°C on water bath at 15 min. Then stain with toluene blue 1% solution then observe under microscope at 500X. Around 100 cells counted. Percentage calculation against degranulation was calculated.[8]

RESULTS AND DISCUSSION

Ethanolic extraction of fruit of *Actinidia deliciosa*

Extraction by hot extraction method: Whole kiwi fruit was peeled and cut into slices, then dried in shade, then grind to get dried fruit powder, this powder is extracted with ethanol by Soxhlet apparatus. Obtained remaining residue solvent were evaporated to the dryness at 50°C. This dried concentrated extract was weighed,and its percentage yield was calculated by following equation which was found to be 12%.[12]

$$Formula\ for\ \%\ yield: \frac{weight\ of\ final\ sample\ x\ 100}{Weight\ of\ powder\ drug} = \frac{6x100}{50} = 12\%w/w\ on\ dry\ wt\ basis.$$

Immunomodulatory activity

Delayed type hypersensitivity model (DTH)

The footpads of mice were sensitized and challenged with OVA and alum combination. Ova challenge group increased the thickness of footpad in ova sensitization mice as compared to the NS group shows that successfully induction of hypersensitivity reaction. The thickness of footpad observed 24 hr after the ova challenge. The footpad swelling was remarkably mitigated by ADFE administration in dependent on dose manner. For the result of footpad swelling the histological examination has been done to see the result distinctively (Figure 1B). Animals belong to test group gets treatment with ADFE 50mg/kg and ADFE100mg/kg and inhibits a decrease in the amount of inflammatory cells (hypersensitivity activity) decrease the hyper reactive immunomodulatory factors as compared to control and standard group (levamisole).The immunomodulatory activity has increased in standard group (0.030±0.007***) and test group of low dose (0.124±0.009**) an high dose (0.1800±0.007*) as compared to normal group and positive control group (Table 1).

The mean ± standard error (SEM) was determined for each group in the experiment.

Result from the study provides the insights of immunomodulation effect of ethanolic extract of *Actinidia deliciosa* showed that it has therapeutic activity for the management of antigen induced (ova induced) DTH (Figure 1A).

Histopathology Images of Delayed Type Hypersensitivity

Neutrophil adhesion test

Mice were well treated with vehicle or extract orally for fourteen days. During day 14, blood sample collected and analyze for TLC and DLC. After incubated with nylon fiber, for 15 min, blood sample analyzed for TLC, DLC.

$$\%\ \text{of Neutrophil adhesion are calculated by formula-}\ \frac{N_{I(UB)} - N_{I(NFTB)}}{N_{I(UB)}} X100$$

Where, $N_{I(UB)}$ -Neutrophil Index of Untreated blood

Table 1: Effect of ADFE by OVA-induced Delayed type hypersensitivity.

Sl. No.	No. of groups	Drug treatment	Edema at 24 hr. in (μm)
1.	Negative control group–I	Distill water (10 mL/kg) P.O	0.025 ±0.001
2.	Positive control group –II	Saline+10 μg ovalbumin + alum 200 μg s.c.	0.228±0.008
3.	Standard group -III	levamisole 10mg/kg p.o	0.030±0.007***
4.	Test group -IV	ADFE (50mg/Kg) p.o.	0.184±0.009*
5.	Test group - V	ADFE (100mg/Kg) p.o.	0.120±0.007**

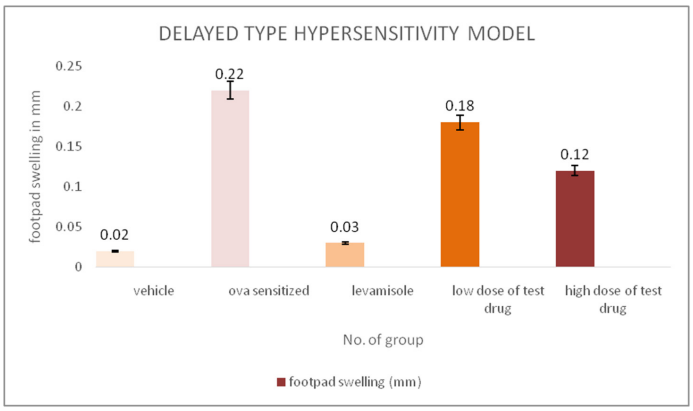

Figure 1A: The effect of ADFE (50 and 100mg/Kg p.o.) + levamisole (10mg/kg p.o.) were expressed in mean ± SEM of 6mice in each group. For a given portion, significant at value presented at $^{**}p < 0.05$ and $^{***}p < 0.01$ in compare to ova sensitized (ANOVA followed by Student's test ethanol extract of *Actinidia deliciosa* (ADFE).

And $N_{I(NFTB)}$-Neutrophil Index of treated blood

Incubation with nylon fibers by blood produce a reduction in the number of neutrophil counts because to adhesion of neutrophils to the fibers which proves the immunostimulant property of standard low dose of test drug and high dose of test drug *Actinidia deliciosa* (Figure 3). The effect of the *Actinidia deliciosa* ethanolic extract, methotrexate and levamisole on neutrophil adhesion are shown in the Table 2.

Abbreviations: TLC: Total leukocyte count; UN: Untreated blood; UNFB: Nylon fiber-treated blood. The effect of ADFE (50 and 100mg/Kg P.O.) +methotrexate 2mg/kg i.p. were expressed in mean ± SEM of six mice in each group n=6.

Anti-asthmatic activity

Milk induce eosinophilia and leukocytes in mice

Blood eosinophilia is a defining feature of asthma. Five groups of mice formed, each with five individuals. Under light ether anesthesia, blood taken from the retro-orbital plexus, there was a difference in eosinophil count before and after administration of milk (Figure 3A).

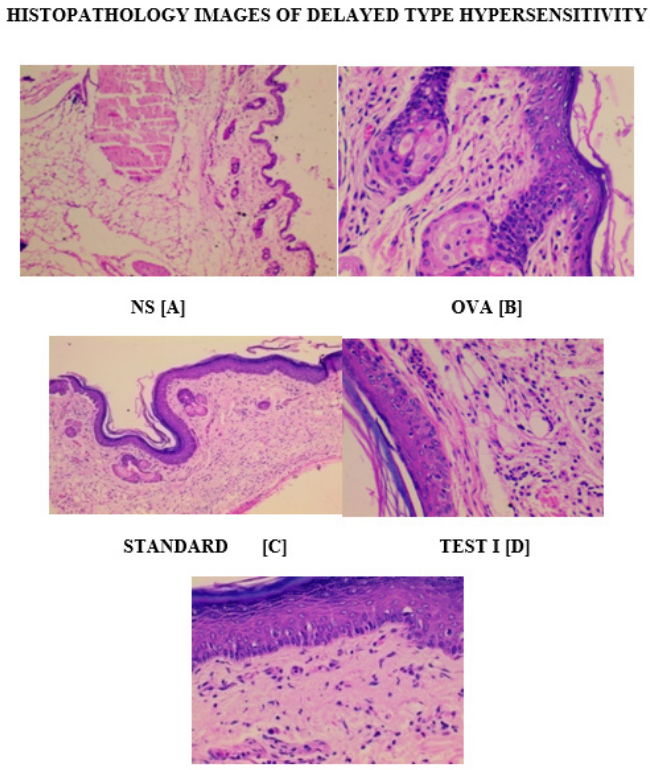

Figure 1B: Hisopathological images shows that there was significant decrease in inflammation at foot paw in the standard group [C]. Low dose [D] and high dose [E] of ethanolic extract of *Actinidia deliciosa* also shows decrease in foot paw swelling cause by Ova sensitization.

Administration of cooled milk at a dosage of 4 mL/kg resulted in a substantial rise in leukocyte and eosinophil counts after 24 hr when compared to the leukocyte count before to milk administration (Figure 3B). Administration of milk (4 mL/kg) subcutaneously exhibit significant ($^{***}p < 0.001$) increase in leukocyte count after 24 hr of administration of milk. But in case of test group, the pre-treatment with the test drug ADFE at 50 mg/kg dose and ADFE at 100mg/kg dose, there was significant ($^{*}p < 0.01$) inhibition was initiate in leukocytes and eosinophilia in mice (Table 3).

Figure 2 shows microscopic images of leukocytes and eosinophilia in blood. There was significant reduction in amount

Table 2: *Actinidia deliciosa* ethanolic extract and methotrexate and levamisole on neutrophil adhesion.

Sl. No.	No. Of Groups	Drug Treatment	TLC (103/mm3)		Neutrophil %		Neutrophil index (AxB)		Neutrophil adhesion %
			UB	NFTB	UB	NFTB	UB	NFTB	
1	Negative Control Group -I	Distill water (10 mL/kg) p.o	5.8± 0.11	6.6 ± 0.09	20.5± 0.45	22.6 ± 0.4	155.8 ± 1.36	138.3 ± 0.73	11.23 ± 0.5
2	Positive Control Group-II	Distill water (10 mL/kg) P.O. +methotrexate 2 mg/kg i.p.	4.0 ± 0.17	2.9 ± 0.17	12.1 ± 0.19	10.8 ± 0.2	32.10 ± 0.84	30.82 ± 0.38	3.9 ±1.5***
3	Standard Group-III	levamisole (10 mg/kg) p.o	7.9 ± 0.11	6.9 ± 0.13	49.67 ± 0.23	31.2 ± 0.5	384.2 ± 1.29	241.1 ± 0.68	37.48*** ± 2.2
4	Test Group-IV	ADFE (50 mg/Kg) p.o	6.8± 0.27	7.5 ± 0.15	40.02 ± 0.85	30.63 ± 0.3	316.9± 1.18	219.2 ± 0.68	31.42* ± 2.8
5	Test Group-V	ADFE (100 mg/Kg) p.o	8.5 ± 0.12	7.7 ± 0.14	53.58 ± 0.43	32.10 ± 0.4	370.3 ± 0.66	232.1 ± 0.73	37.32*** ± 2.0

Table 3: Effect of ADFE on milk-induced leucocytosis and eosinophila in mice.

Sl. No.	No. Of Groups	Drug Treatment	Difference in No. of leucocytes (per cu mm)	Difference in No. of eosinophils (per cu mm)
1	Negative Control Group-I	Distill water (10 mL/kg) *p.o.*	80± 8.15	21.8±3.17
2	Positive Control Group-II	Distill water (10 mL/kg) P.O. +boiled and cooled milk 4 mL/kg *s.c.*	4953 ± 491.2***	162.4±9.51***
3	Standard Group-III	Dexamethasone (50mg/kg) *i.p.*	1400 ± 161.08*	100.8±9.123**
4	Test Group-IV	ADFE (50mg/Kg) *p.o.*	3520 ± 275.5*	129.2±2.81*
5	Test Group-V	ADFE (100mg/Kg) *p.o.*	2362 ± 275.4**	116±1.94**

The effect of ADFE (50 and 100mg/Kg P.O.) + boiled and cooled milk (4 mL/kg S.C.) were expressed in mean ± SEM of 6 mice in each group. For a given portion, significant at value presented at $p<$ 0.05* for low dose of test drug, $p<$ 0.01** for high dose of test drug and $p<$ 0.001*** for standard as compared to control (ANOVA followed by Dunnett's test ethanol extract of *Actinidia deliciosa* (ADFE).

of eosinophilia and leukocytes in standard [C] and low dose [D] and high dose [E] of test group as compared to the positive control group [B] and vehicle treated group[A].

Clonidine induced catalepsy in mice

All groups showed a max. time period of catalepsy at 120 min after the clonidine administration. The positive control group showed highest length of time of catalepsy (296.5 ± 20.7 sec.) at 120 min after the administration clonidine (Figure 4A). There was notable inhibition (*p<0.05) of clonidine-induced catalepsy in the animals pre-treated with ADFE (30, 60, 90,120 min) (Table 4). Chlorpheniramine maleate (10 mg/kg, p.o.) remarkably inhibit (**p<0.01) the clonidine-induced catalepsy in mice at 120 min after the administration of clonidine.

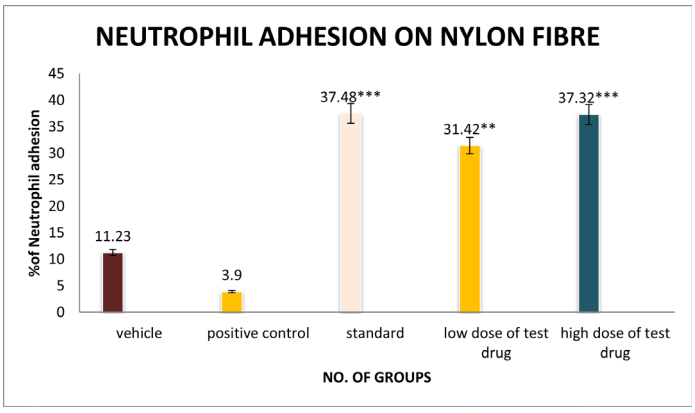

Figure 2: Estimation of the % of Neutrophil adhesion. In the above result the values are expressed as mean± SEM of these five observations. The outcome of the result when compared with the control group the test drug found to be ***p<0.001 and is considered very significant.

Table 4: Effect of ADFE and synthetic L-dopa on clonidine-induced catalepsy in mice.

Sl. No	No. Of Groups	Drug Treatment Concentration (Mg/Kg)	Duration of catalepsy (MEAN ± SEM) in seconds				
			0 min	30 min	60 min	90 min	120 min
1	Negative Control Group-I	Saline Treated (10mg/kg) *p.o.*	0.0	80.60± 13.98	147.2± 28.46*	152.0± 30.85	169.8± 8.71
2	Positive Control Group-II	Saline+Clonidine (1mg/Kg) *p.o*	8.0± 0.44	186.0± 7.45	220.25± 28.46	262.75± 4.64	296.5± 20.7
3	Standard Group-III	Chlorpheniramine (10mg/Kg) *p.o*	2.0± 0.44*	60.0± 7.45	90.25± 28.46*	132.75± 4.64	176.5± 20.7
4	Test Group-I	ADFE (50mg/Kg) *p.o*	6.04.0 ± 0.32	172.08± 29.82	210.6± 28.46	249.0± 24.5	272.0± 5.23
5	Test Group-II	ADFE (100mg/Kg) *p.o*	5.2± 28.46*	139.70± 28.46*	171.85± 28.46*	221.30 ±0.010	252.0± 5.23*

The effect of ADFE (50 and 100mg/Kg P.O.) + Clonidine (1mg/Kg P.O) were expressed in mean ±SEM of 6 mice in each group. For a given result, significant at value presented at $p< 0.05$* and $p< 0.001$** as compared to control (ANOVA followed by Dunnett's test ethanolic extract of *Actinidia deliciosa* (ADFE).

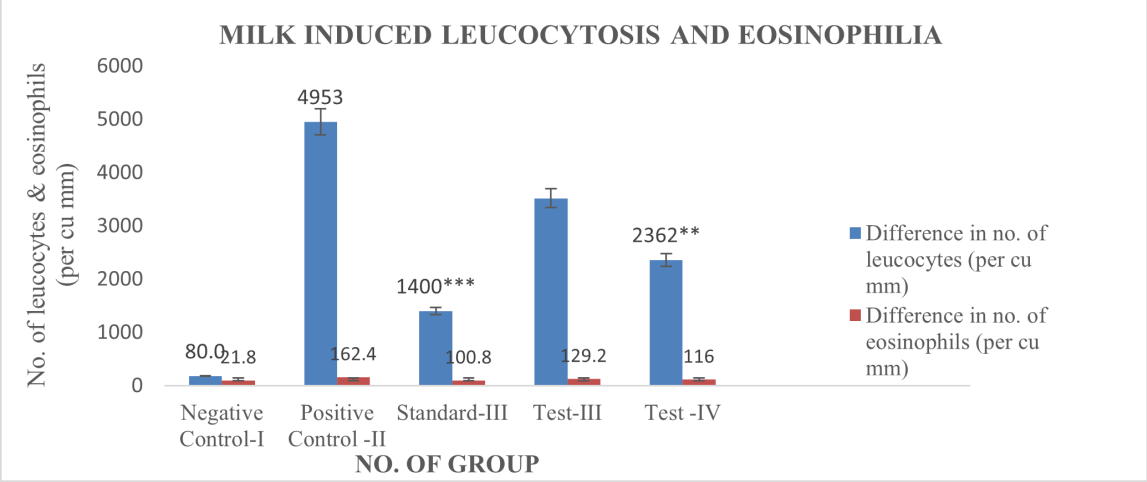

Figure 3A: Estimation of effect of ADFE on no. of eosinophilia and leucocytes in mice.

Table 5: Estimation of the effect of ADFE and on Clonidine-induced mast cell degrannulation in mice.

Sl. No	No. Of Groups	Drug Treatment Concentration (Mg/Kg)	% Protection of mast cell degranulation
1	Negative Control Group-I	Saline treated (10mg/Kg) *p.o*	23±0.44
2	Positive Control Group-II	Clonidine 80mcg/kg i.p.	15.6 ± 1.03
3	Standard Group-III	Sodium Cromoglycate(50mg/Kg) *p.o.*	74.4 ± 0.92****
4	Test Group-IV	ADFE (50mg/Kg) *p.o*	33.2 ± 0.75***
5	Test Group-V	ADFE (100mg/Kg) *p.o*	43 ± 1.15***

The effect of ADFE (50 and 100mg/Kg P.O.) and sodium chromoglycate (50mg/kg)were expressed in mean ± SEM of six mice in each group n =5. For a given portion, analysis performed by using One –way ANOVA. In comparison with the positive control group, p value is 0.001***, 0.0001**** respectively.

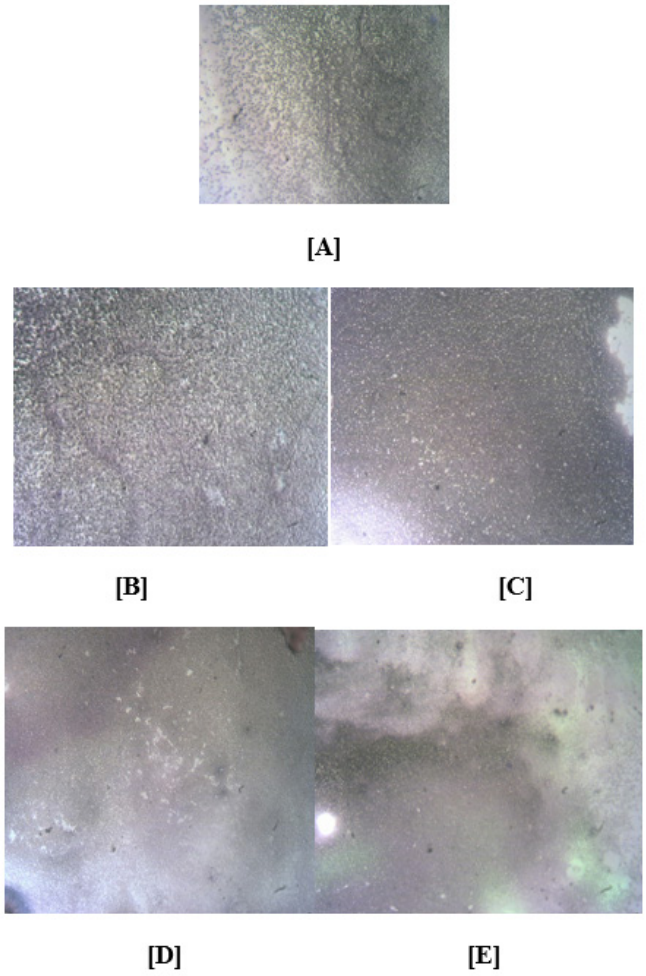

Figure 3B: Microscopic images of leucocytes and eosinophilia in blood.

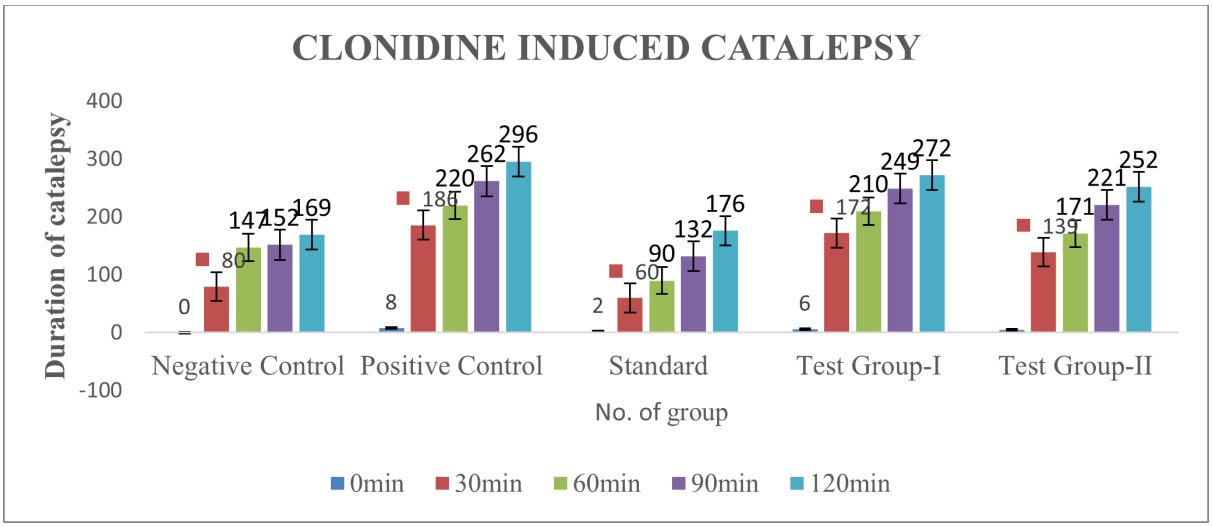

Figure 4A: Shows clonidine induced catalepsy in mice on different time duration.

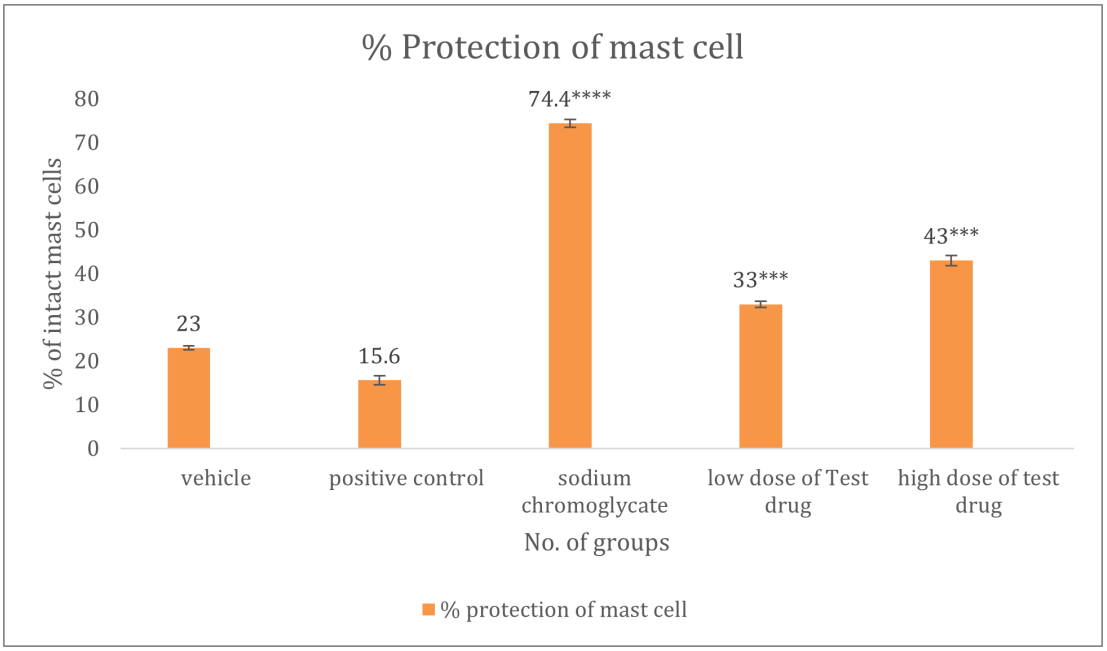

Figure 4B: Shows % of protection of clonidine induces mast cell degranulation.

Effect of Low and high dose of ethanolic extract of Actinidia deliciosa (test drug) for mast cell protection.

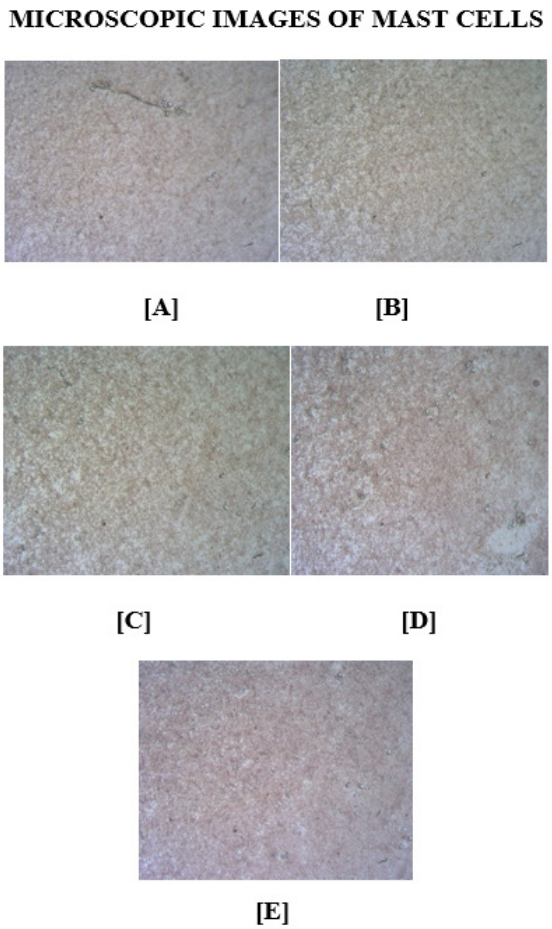

Figure 5: Microscopic images of mast cells degranulation.

There were significantly more mass cell degranulation in [C] as compared to [C], [D] and [E] which are standard, low dose and high dose of test drug treated. The result analysis of mass cell counts between these groups are shown in Table 5.

Clonidine induced mast cell degranulation

Percentage protection of mast cell degranulation mice is calculated by formula:

$$\frac{\text{Total no. of mast cells} - \text{Total no. of degranulated cells } X\ 100}{\text{Total no. of mast cell}}$$

Minimum 100 Mast cell were counted from different visuals and their percentage of intact has been determined (Figure 4B).

The effect of ADFE (50 and 100mg/Kg P.O.) and sodium chromoglycate (50mg/kg) were expressed in mean ± SEM of six mice in each group n=6. For a given portion, analysis performed by using One –way ANOVA. In comparison with the positive control group, P value is 0.001***, 0.0001**** respectively.

Effect of Low and high dose of ethanolic extract of fruits of *Actinidia deliciosa* (test drug) for mast cell protection.

Microscopic Images of Mast Cells

There were significantly more mass cell degranulation in [B] as compared to [C], [D] and [E] which are standard, low dose and high dose of test drug treated (Figure 5). The result analysis of mass cell counts between these groups are shown in Table 5.

CONCLUSION

The findings of present research work are based on immunomodulatory and anti-asthmatic activity of *Actinidia deliciosa* fruit extract which showed that ethanolic extract of *Actinidia deliciosa* is capable for increased immune responses in Swiss albino mice. The ethanolic extract of fruit of *Actinidia*

deliciosa has therapeutic potential to alleviate various disease condition symptoms controlled by immunomodulation.

Delayed type hypersensitivity

The present study showed ethanolic extract of *Actinidia deliciosa* effect on OVA challenged mice resulting delayed type hypersensitivity showed suppression effect on DTH reaction. Result from the present work showed the insight of immunomodulatory effect of *Actinidia deliciosa* on delayed type hypersensitivity reaction.

Neutrophil Adhesion Test

In the present study neutrophil adhesion of standard and test drug is compared to disease control. Standard group showed significant rise in the neutrophil adhesion as compared with the disease control. The comparison of standard drug with ethanolic extract of *Actinidia deliciosa* at a dose of 50 mg/kg and test 100 mg/kg were done to get the results.

The result of present research study showed that ethanolic extract of *Actinidia deliciosa* is a immune system booster as the high dose of *Actinidia deliciosa* 100 mg/kg showed significant increase in neutrophil adhesion. The exact constituents responsible for its immunostimulant property is not known further molecular studies has to be done to determine its immunostimulant property.

Milk induced eosinophilia and leucocytes in mice

The administration of milk through parenteral route showed significantly increasing leukocytes and eosinophilia count after 24 hr of the administration the model milk induced leucocytes and eosinophilia in mice.The result of this present the search work revealed that ethanolic extract of *Actinidia deliciosa* cause decrease in count of these inflammatory cells this is totally extract shows significant activity as compared to control group.

Clonidine induced catalepsy in mice

From the research study, the ethanolic extract of fruit of *Actinidia deliciosa* showed notably reduction in cataleptic affect. The effects seen even after 120 min. *Actinidia deliciosa* prevented clonidine-induced catalepsy. According to the findings of this study, the cataleptic action of clonidine in mice is arbitrate by histamine production from mast cells, and the extract of *Actinidia deliciosa* possesses antihistaminic activity.

Clonidine induced mast cell degranulation

From the research study it can be concluded that the result obtained from investigation of ethanolic extract of *Actinidia deliciosa* showed significant mass cell stabilizing event which clears that it has potential to be used as prophylaxis treatment of asthma still clinical investigations needs to be done to evaluate the other phyto constituents present in *Actinidia deliciosa* which can show broncodilating effect and can be used for clinical treatment of asthmatic patient.

ACKNOWLEDGEMENT

Authors acknowledge expressing our sincere gratitude to the management of Noida Institute of Engineering and Technology, (Pharmacy Institute) for continuous support, motivation, enthusiasm and immense knowledge.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

IAEC: Institutional Animal Ethics Committee; **CPCSEA:** Committee for the Purpose of Control and Supervision of Experiments on Animals; **DTH:** Delayed Type Hypersensitivity; **OVA:** Ovalbumin; **TLC:** Total Cell Count; **DLC:** Differential Cell Count; **RPMI:** Roswell Park Memorial Institute Medium; **SEM:** Standard Error Mean; **ANOVA:** Analysis of Variance; **UB:** Untreated Blood; **UFTB:** Nylon Fiber Treated Blood.

SUMMARY

In recent years, there has been growing interest in the field of herbal medicines research and search for promising potential compounds for investigating the immunomodulatory and antiasthmatic drugs from natural products. Plants are the essential and integral part in Complementary and Alternative Medicine (CAM) and a number of medicinal plant products which has been used widely now a days to treat various immunological diseases which are in turn used to restore health and heal many diseases. The purpose of this research paper is to highlight the results of research done on *Actinidia deliciosa* fruit extract, which revealed the potent immunomodulatory and antiasthmatic properties of plant. This work shall hopefully encourage researchers to undertake further work on medicinal plants with potential immunomodulatory and anti-asthmatic activity.

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Cite this article: Das S, Das S, Pal S. Anti-Asthmatic and Immunomodulatory Effect of *Actinidia deliciosa* fruit on Swiss albino mice. Indian J of Pharmaceutical Education and Research. 2024;58(1):162-71.