International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 05-12-2021, Accepted: 21-12-2021, Published: 06-01-2022
Volume 7, Issue 1, 2022, Page No. 103-106

Adaptogenic activity of alcoholic extract of *Solanum xanthocarpum* (Schrad. & wendl.)

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Abstract
The *Solanum xanthocarpum* is a plant, which is used, in herbal preparations, as anti-asthmatic, anti-cough, and in the treatment of arthritis. Suppression & retention of urine, fever etc. was investigated for its immunostimulant activity. The ability of *Solanum xanthocarpum* ethanolic extract to give anti stress (adaptogenic) effect has showed significant increase in the duration of swimming (in treated group) as compared to the control group. The control group rats treated group of rats swam for 80.66 min (mean) where us the drug treated group of rats swam for 139.66 min. The drug treated rats showed significant increase in swimming time and registered an increase in swimming time of more than 59 min (total) over the control group. Similarly ethanolic extract of *Salanum xanthocarpum* was subjected for another test i.e. milk induce leucocytosis by giving S.C. Inj. of milk in doses of 4 ml/kg. Body weight produced a marked and significant increase in the leucocytes count after 24 hour of its administration. After given the ethonolic extract of Solanum Xanthocarpu, it was seen that the average leucocyte count was markedly reduced from 13883 to 1055.6. The preliminary results clearly indicate that leucocytosis induced by milk inj. was significantly inhibited by prior treatment of rats with ethanolic extract of *Solanum xanthocarpum* in the doses of 100 mg/ kg I.P. in 2% PVP solution.

Keywords: *Solanum xanthocarpum*, adaptogenic, leucocytosis

Introduction
Stress is a non-specific response of body known to alter the physiological homeostasis of the organism resulting in various endocrinal and visceral responses [1-2]. The immune system plays an important role in biological adaptation, contributing to the maintenance of homeostasis and to establishment of body integrity. Hence the experimental work related to adaptogenic effect should not only explore the antistress effect but should also account in the improvement of defense mechanism of the host. *Solanum xanthocarpum* (Family- Solanaceae) has been reported in the ayurvedic system of medicine for the treatment of fever, cough. Asthma and costiveness [3-4]. It has also been reported that its powder has showed marked effect in the treatment of bronchial asthma [5]. In the present investigation ethanolic extract of roots of S. xanthocarpum has been evaluated for its effect on forced swimming stress and milk induce leukocytosis to study adaptogenic activity.

Materials and Methods
Collection and Identification of Drug: The plant of *Solanum xanthocarpum* was collected from out field. The roots of plant were dried in shade, powdered and used for extraction drug was identified by Herbarium in Govt. Agriculture College Mandsaur.

Extraction of drug: The powdered drug, weighing about 60 gm was taken and extracted in Soxhlet apparatus with the petroleum ether for defatting of drug. After defatting the extract was concentrated by distilling the solvent and the extract wad dried in an oven 50° c. The drug was dried in hot air oven below 50^0 c & extracted with 70% ethanol. The solvent was evaporated in order to concentrate the extract. The extract so obtained was dried in a vacuum desiccator and then the consistency, colour, appearance of the extract and their percentage yield was noted. Preliminary phytochemical screening of extracts was carried out for the presence of phyto-constituents like alkaloids, flavonoids, steroids and saponins [6] then the extract was assesed for adaptogenic activity.

Experimental Animals
Wistar albino rats (150-200 gm) of either sex were obtained from Animal House of B.R. Nahata College of Pharmacy, Mandsaur for the study. Animals were maintained under normal environmental condition: (Room temperature - 27 ± 3°C, Relative humidity - 65 ± 10 %, 12 h light / dark cycle). The animals were fed with standard diet and water was given *ad libitum* under strict hygienic conditions. The permission of Institutional animal ethical committee was obtained before starting the experiments (approved proposal No. (01/M.Ph/05/IAEC/BRNCOP). All Experiments were performed in accordance with the current guidelines of CPCSEA, Government of India [7].

Evaluation of Immunomodulatory Activity
Adaptogcnic activity: The immune system plays an important role in the biological adaptation by contributing to the person by the maintenance of homeostasis and to establishment of body integrity. So the experimental work which is related to adaptogenic effect should not only explore the anti-stress effect, but should also account for the improvement of the defense mechanism of the host. The adaptogenic activity was measured by the following two methods [8-10].

1. Forced swimming stress test.
2. Milk induced leucocytosis.

1. Protocol for forced swimming stress test [8]
Two group of (6 rats in each group) were used. One group served as a control and other was treated with ethanolic

extract of *Solanum xanthocarpum* 100mg/kg (body weight) in 2% PYP solution I.P. one hour before the experiment. Mice were allowed to swim till exhausted in separate tank filled with water. The end point was taken when the animal drowned and swimming time for each animal was noted. The mean swimming time for each group was calculated.

Forced swimming stress test.

The physical stress was exerted by keeping the animal (albino rats) in cylindrical vessel made of glass (length 48 cm & diameter 30 cm) field with water up to a height 01'25 cm. The physical stress was applied in the form of swimming. The time required to animal to get exhausted i.e. swimming time is measured. Two group (each contain albino rats.) were made to swim separately and swimming time (total) for each group was noted and time was taken so that mean time for each group was calculated.

The point of exhaution is taken when the. animals remain floating passively in water. In an upright position making only ~mall movement to mainitain the head just above the water level. (Figure 1) The effect of drug under test, on swimming time is measured and the results are shown in given table no. I

Fig 1: Forced Swimming Stress Test

Table 1: Effect of ethanolic extract of *Solanum xanthocarpum* on swimming performance

Group	Condition	Rat no.	Duration of swimming (min.)	Mean duration (min.)
I	Control	1	82	80.66
		2	74	
		3	68	
		4	88	
		5	94	
		6	78	
II	Treated	1	142	139.66
		2	130	
		3	138	
		4	138	
		5	146	
		6	144	

2. Protocol for milk induced Leucocytosis [9, 10].

There groups each contain 6 albino rats were taken and used. The total leucocyte was done for each group before the experiment. Group one was taken as a normal group. Group second was taken as controlled in which the sterile milk inj. 4ml/kg. s.c. was administrated. In group 3 ethanolic extract of *Solanum xanthocarpum*, 100mg/kg. (Body weight) Intraperitoneal was administered I hour before the milk injection. The leucocyte count was done again after 24 hour of the milk inj.

Milk induced leucocytosis

Increase in W.B.C count above 11000 per M.M [3]. is called leucocytosis. In this test inj. Of foreign protein in the form of sterile milk imposes biological stress leading to leucocytosis. (Figure 2) The. Animal were divided in to three groups normal. Control and treated. The blood sample were collected from lateral tail vein and the total leucocyte count was done in each group before milk or dr.ug administration and the results are shown in given table no. 2 [11].

Fig 2: Milk Induced Leucocytosis

Table 2: Effect of *Solanum xanthocarpum* ethanolic extract on milk induced leukocytosis

Group	Drug dose/kg	Leucocyte count before any treatment (Avg.)			Leucocyte count after 24 hrs.		
		Rat no	Leucocyte	Avg.	Rat no	Leucocyte	Avg.
I	Control Milk 4 ml/kg S.C.	1	9120	8880	1	14260	14770
		2	8640		2	15180	
		3	8700		3	14800	
		4	8900		4	14500	
		5	9100		5	15100	
		6	8820		6	14780	

II	Standard Vit. E 150 mg/kg. I.P. + milk 4 ml/kg S.C.	Rat no	Leucocyte	Avg.	Rat no	Leucocyte	Avg.
		1	9260	9580	1	11140	11420
		2	9910		2	11700	
		3	8700		3	11980	
		4	9800		4	11000	
		5	9860		5	11200	
		6	9950		6	11500	
III	Treated Sol. Xanth extract 100 mg/kg + milk 4 ml/kg. S.C.	Rat no	Leucocyte	Avg.	Rat no	Leucocyte	Avg.
		1	9200	9223	1	10280	10310
		2	8980		2	10340	
		3	9200		3	10880	
		4	8800		4	9900	
		5	9120		5	10120	
		6	9240		6	10340	

Result and Discussion

Our present study investigated that stress alters normal biochemical and hematological parameters, which may disturb immune system [12]. The ability of *Solanum xanthocarpum* ethanolic extract lo give anti stress (adaptogenic) effect has showed significant increase in the duration of swimming (in treated group) as compared to the control group. The control group rats treated group of rats swam for 80.66 min (mean) where as the drug treated group of rats swam for 139.66 min. The two group i.e. control and treated were taken. In control group 6 rats numbered 1, 2, 3, 4, 5, 6, were taken. The swimming performance of rats in 'control group was 82, 74, 68, 88, 94, 78 min was noted. When the rats were treated with ethanolic extract. The swimming 142, 130, 138, 146, 144, min was noted in treated group. So, The drug treated rats showed significant increase in swimming time and registered an increase in swimming time of more than 59 min (total) over the control group.

S.C. Inj. of milk in doses of 4 ml/kg body weight produced a marked and signiticant increase in the leucocytes count after 24 hour of its administration. In group I (normal) the six rats were marked 1, 2, 3, 4, 5, 6, and the leucocyte count 9450, 9100, 8980, 9160, 8600, 8940 was found. After 24 hr. Leucocyte count was 9100, 9420, 8960, 9180, 8600, and 8940.

In group II the sterile milk 4 ml/kg body weight was given S.c. and the leucocyte count before Inj. was discovered to 8780, 9340, 9680, 9020, 9260, 8680 and after 24 hrs of the milk Inj. The leucocyte count was found to be 14880, 13980, 13800, 14140, 13640, and 12860. Similarly in III group *Solanum xanthocarpum*, extract (100mg/kg) body weight was given before the milk Inj. The Leucocyte count before treatment was 9050, 9090,8200,9760,9940, and 9300. And after treatment (24hrs. later) the total leucocyte count was found to be 10800, 10840, 10120, 10160, 10680, and 10240 [13-15]. The ethanolic extract of *Solanum xanthocarpum* reduced the average leucocyte. The leucocyte reduced from 13883 to 10556. The preliminary results clearly indicate that leucocytosis induced by milk inj. was signiticantly inhibited by prior treatment of rats with ethanolic extract of *Solanum xanthocarpum* in the doses of 100 mg/ kg I.P. in 2% PVP solution.

Conclusoin

The results explore the potenlial of Solanum xanthocarpun plant against physical stress, as there is significant rise in swimming time in treated rats, drug is also capable of managing biological stress induced by the foreign protein. The present studies clearly indicated that plant Solanum xanthocarpun plays an important role in maintenance of physical and biological stress. The plant drug potentiate for biological adaptation by maintenance of heamostasis and body integrity.

Acknowledgement

The author is highly thankful to his guide Dr. Vipin Bihari Gupta for his kind support and suggestions and also to B.R. Nahata College of Pharmacy for providing necessary research facilities during the course of study.

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