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IN VIVO EFFECTS OF VENOM TOXINS OF *POLISTES FLAVUS* ON THE LEVEL OF GLYCOGEN CONTENT IN LIVER, GASTROCNEMIUS AND CARDIAC MUSCLES OF ALBINO MICE

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ABSTRACT

Objective: In this investigation, the wasp species *Polistes flavus* were collected ad isolated the venom proteins and purified it. The wasp venom induce biological effects on the alteration of glycogen in the liver and muscles tissue of albino mice. **Method**: The wasp venom toxins isolated from the venom gland and purified by Sepharose CL-6B-200 a double cavity gel filtration column chromatography. The LD_{50} was determined by probit analysis. For biological toxicity, we introduce sub lethal dose 40% and 80% of 24-h LD_{50} in the body of weighted albino mice and observe all the alteration in the glycogen level in muscles and liver tissue with compare to control, according to Dubois method. **Result:** The molecular weight of venom protein was ranging from 14.3-63 kDa and the LD_{50} of the yellow wasp *Polistes flavus* venom protein was found 0.03611 mg/gram body weight of albino mice. The mice treated with 40% and 80% of 24-h LD_{50} of purified venom toxin significantly alter the level of glycogen content were measured in the liver, gastrocnemius muscles and cardiac muscle such as auricle and ventricle of albino mice. **Conclusion**: The venom toxin of *Polistes flavus* possesses varieties of enzymes, proteins, peptides, volatile compounds, and bioactive compounds such as phospholipase A2, antigen 5, mastoparans and decoralin by which its biological effects causes alteration in the biomolecules and breakdown of glycogen in liver and muscles of victims. The carbohydrate

is the stored in the form of glycogen in animal tissues in which liver and muscles are the storable organ in animal. Wasp venom shows significant alteration in glycogen level with dose and time dependant responses.

KEYWORDS: *Polistes flavus*, Glycogen level, Gastrocnemius, Auricle, Ventricle muscles.

INTRODUCTION

In the world there are more than 150,000 venomous animal species such as snakes, bees, wasps, scorpions, and spiders, venomous lizards, sea anemones, cone snails, and even a few mammals, like the duck-billed platypus with its venom-bearing ankle spurs.[1] These poisonous animals are widely distributed throughout the world and venomous animals evolved defence organs such as fangs, nematocysts, spines, stings and pincers etc. The venom bearing insects such as wasps and honey bees react and respond very fast to make an attack on predators and mammals. Envenomation and poisoning by terrestrial animals mainly hymenopterans is a significant problem for health and their stings only cause local inflammation in most people.[2]

Hymenopteran such as bees and wasp venom are highly active as they block various channels and breach the normal barrier for free movement of molecules across cell membrane[3] and also cause acute and chronic inflammatory responses. On the other hand, venoms contain substances with unique biological properties, which can be used both in basic science and in clinical applications.[4] Among venomous animals such as hymenopterans have been suggested as a rich source of natural toxins. Due to their broad ecological diversity, venom from hymenopteran insects (bees, wasps and ants) have evolved differentially thus widening the types and biological functions of their components. The insect toxicology analysis had scarcely uncovered the complex composition of bees and wasps contain low molecular weight compounds such as proteins, allergens and toxic peptides.[5] The evaluation of venom protein of hymenopterans bias by studying their origins, sequence diversity, known structures and biological functions.[6]

Hymenopteran venoms are constituted by a complex mixture of chemically or pharmacologically bioactive agents, such as phospholipases, hyaluronidases and mastoparans.[7] The wasp species have a wide varieties of enzymes, proteins, peptides, volatile compounds, and bioactive constituents, which include phospholipase A2, antigen 5, mastoparans and decoralin. The bioactive constituents have anticancer, antimicrobial, and

anti-inflammatory effects.[8] The wasp species seems to be a health problem in the countries where they are native due to their sting, which in the most severe cases can lead to severe or fatal systemic anaphylaxis[9] and also impose multisystem changes and show wide range biological activities such as intravascular haemolysis, rhabdomyolysis [10] acute renal failure, cardiac, involvement, hepatic dysfunction and occasionally thrombocytopenia and coagulopathy.[11] The wasp *Ropalidia marginata* venom causes significant alteration in the biomolecules in albino mice and changes in the concentration of biomolecules such as protein, free amino acids, uric acids, cholesterol and glucose levels. It also causes glycogen alteration in liver and gastrocnemius muscles in albino mice.[12] The venoms can also contain substances that are able to inhibit and/or diminish the genotoxic or mutagenic action of other compounds that are capable of promoting damages in the genetic materials.[13] Consequently, compromised energy balance and metabolic control are potential complications of lowered glycogen storage in the liver.

MATERIAL AND METHOD

1. **Collection of yellow wasp**- The living yellow wasp species *Polistes flavus* were collected from different regions of Gorakhpur city. The collected wasps were immobilized by quick freezing at -20° C. The venom glands were taken out by cutting the last two segment of abdominal region of wasp and these were homogenized in phosphate buffer saline (50 mM, pH 6.9) with the help of power homogenizer. The homogenate was centrifuged at 10000 rpm at 4°C for 10 minutes and the supernatant was used as crude venom.

2. **Preparation of Homogenate**- Equal amount of isolated wasp venom glands were homogenized properly in a glass-glass homogenizer in 5 ml of different solubilizing buffers such as Triton X-100, Phosphate Buffer Saline (pH 6.9), 10% TCA, Tris-EDTA and absolute ethanol separately. Homogenate was centrifuged at 12000 rpm in cold temperature for 30 minutes and supernatant was separated out. Total protein contents were estimated in the different supernatants according to the Lowry's (1951) method [14] (Figure 1).

3. **Purification of venom protein of Yellow wasp**- Proteins were eluted on a Sepharose CL-6B-200 a double cavity gel filtration column with sintered disc filtered in the bottom 70 having a height of 1 meter in 25 mm diameter. A known volume i.e., 5 ml of toxin proteins solubilized in phosphate buffer saline (PBS) was loaded in the column and the flow rate between 1 ml/minute was maintained by a continuous buffer supply in a cold

room. Eluted fractions collected at a fixed time interval using a Pharmacia fraction collector and the values of protein concentration in different eluted fractions were plotted on graph; absorbance in each fraction was determined at 280 nm (Figure 2). The eluted fractions containing venom protein were pooled and lyophilized to a desired concentration of the venom proteins. The lyophilized venom protein was filled in the dialyzing bag and dialyzed with three changes of phosphate buffer (50 mM, pH 6.9) to remove the excess salt from the lyophilized protein venom solution of *Polistes flavus* (Figure 3).

4. **Molecular weight determination of purified venom proteins-** Range of molecular weight of different proteins/toxins in the purified wasp venom was determined by running the proteins of known molecular weight through Sepharose CL-6B gel column as done previously at the same flow rate. A calibration curve was drawn between Ve/Vo log M and with the help of calibration curve range of molecular weight of different protein in the purified yellow wasp *Polistes flavus* venom was determined (Figure 4).

5. **Determination of the lethality of *Polistes flavus* venom toxins-** The albino mice were injected subcutaneously with the purified venom toxins of different serial concentration and LD_{50} was determined at the intervals of the 24 hours. Deformities such as paralysis and neurotoxic effects were also recorded. Mortality was determined by using Abbot's formula. The LD_{50} values were calculated at which half of the test animals were died. The lethal concentration for 40% and 80% of the LD_{50} was determined with the doses-mortality regression line plotted on the log Probit method's (Fenney 1971).[15] The confidence limits were calculated at 95% probability levels.

6. **Determination of glycogen in the tissue of liver, and heart and gastrocnemius muscle-** This section deals with the study of effects of the purified venom toxins on the glycogen level in the liver, gastrocnemius muscles auricle and ventricle of albino mice. Albino mice were treated with 40% and 80% of 24-h LD_{50} of purified *Polistes flavus* venom and glycogen level estimation of control and treated albino mice**,** the mice were dissected after 2, 4, 6, 8 and 10 hours of treatment and liver, muscles of gastrocnemius and cardiac such as auricle and ventricle were remove out quickly and in cold condition glycogen contents were estimated. Wasp venom caused significant ($p<0.05$) decrease in glycogen level in the liver, gastrocnemius muscles, auricle and ventricle of albino mice (Table 1 & 2).

Glycogen contents were measured according to the method of Dubois et al., 1956.[16] For estimation of glycogen, 1 gram of liver, gastrocnemius muscles, heart were taken out from the body of albino mice and homogenized in 2 ml of 10% Trichloroacetic acid (TCA) and centrifuged at 10000 rpm for 10 minutes. After centrifugation the supernatant was transferred into a clean 100 ml graduated cylinder and added 3 volumes of 95% ethanol was added. Mixture was stirred until a precipitate flocculated. A pinch of NaCl was added to intensify the precipitation. For flocculation of precipitation, graduated cylinder was placed in warm water. The solution was centrifuged and separates the precipitate and supernatant was discarded. The white precipitate was dissolved in 5 ml of distilled water and then added 10 ml (2 volumes) of 95% ethanol in it. The whole mixture was centrifuged again and the precipitate was separated in clean measuring test tube and dissolved it in 15 ml of distilled water. A set of 6 test tubes was arranged of which 4 containing standard glucose solution of known concentration. Remaining 2 tubes were contained 0.5 ml of unknown aqueous glycogen solution. 6 ml of concentrated H_2SO_4 was added and test tubes were kept in boiling water bath for 5 minutes. Absorbance was noted at 530 nm and the amount of glycogen contents were determined by using standard glycogen curve (Table 1 and 2; Figure 6, 7, 8 and 9).

RESULT

1. **Solubilization of venom gland of yellow wasp-** For solubilization of venom proteins isolated from wasp *Polistes flavus* in different solubilizing buffers viz. Triton X-100, Phosphate buffer saline (50 mM, pH 6.9), 10% Trichloroacetic acid (TCA), Tris-EDTA and absolute alcohol were used. Among which Triton X-100 was proved to be a good solubilizing agent for the wasp venom proteins. A decreasing order was obtained in solubilization of venom proteins in different buffers was- Triton X100>Tris-EDTA> 10% TCA> absoluter alcohol> PBS (Figure 1).

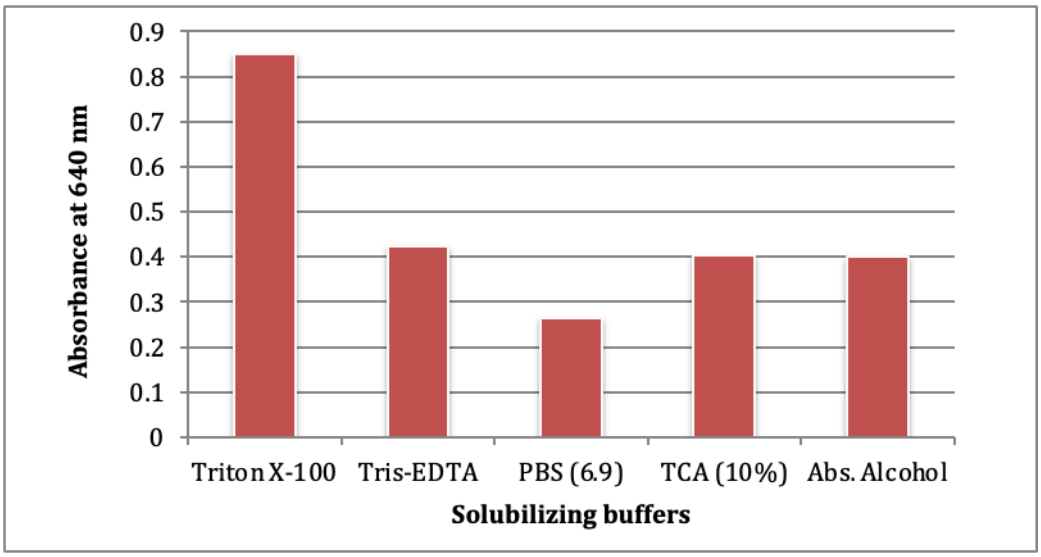

Figure 1: Solubilisation of venom proteins of *Polistes flavus* in different buffers was taken at 640 nm absorption by spectrophotometer. The solubilizing buffers were (i) Triton X 100, (ii) Tris-EDTA, (iii) phosphate buffer saline (6.9 pH), (iv) 10% Trichloroacetic acid (TCA) and (v) absolute alcohol on X-axis and their absorption was on Y-axis.

2. **Sepharose CL-6B 200 column chromatography-** The elution pattern of purified and homogenized venom glands of yellow wasp exhibited two major peaks at 280 nm in the fraction no. 41-61 and fraction no. 81-101. These were pooled in separate tubes (Figure 2). Further, protein estimation revealed two peaks at 640 nm, first was major one between the fractions no. 46-51 and second a major peak between fractions 60-101. Both peaks were coinciding with first chromatogram obtained at 620 nm. Both peaks were eluted with 0.13M NaCl PBS buffer (pH 6.9) and protein estimation was done for each fraction by Lowry´s method. The total yield of protein was 56.23% and specific activity was determined in each fraction (Figure 3).

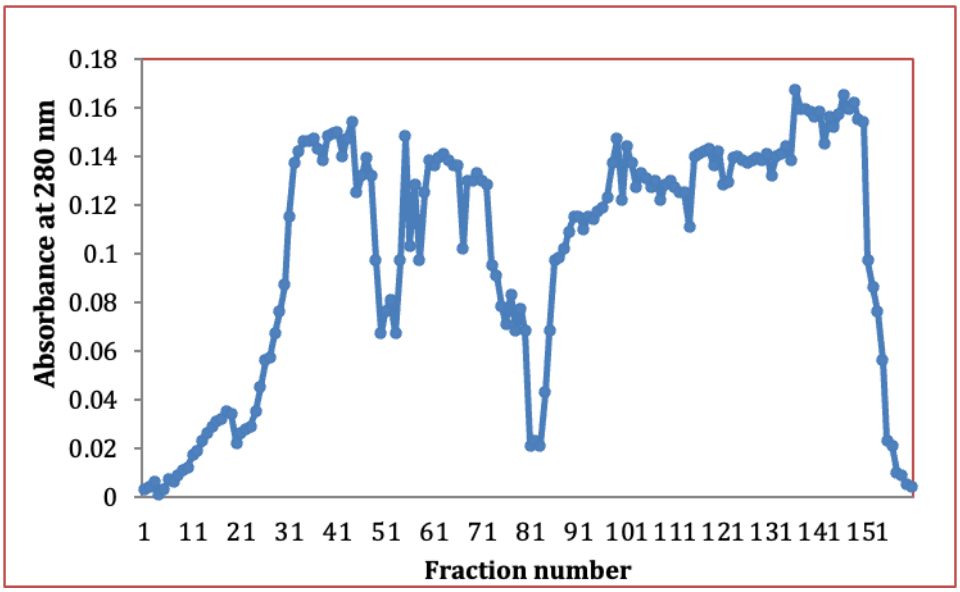

Figure 2: Elution patterns of phosphate buffer (50 mM, pH 6.9) extractable venom proteins of yellow wasp *Polistes flavus* chromatographed on Sepharose CL-6B column. Absorbance was taken at 280 nm.

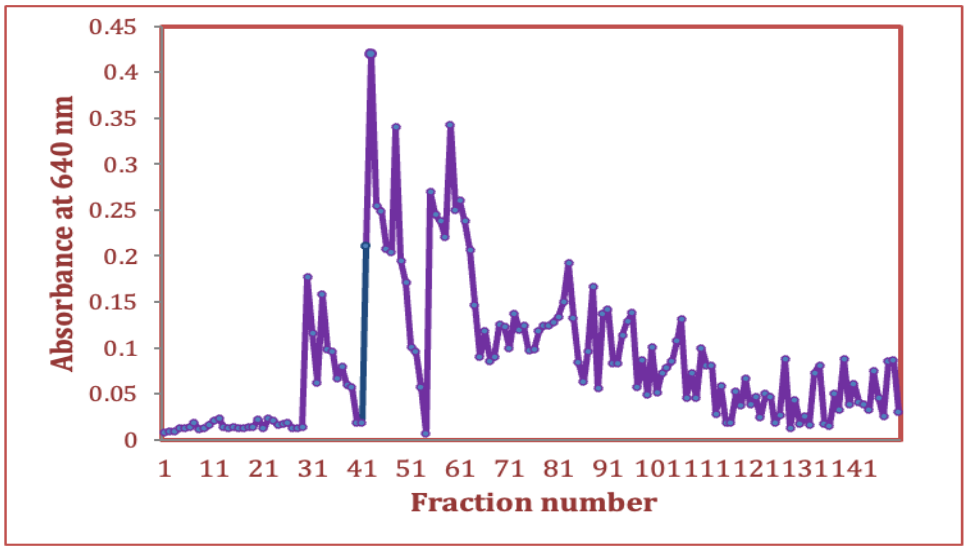

Figure 3: Elution pattern of phosphate buffer (50 mM, pH 6.9) extractable venom proteins of yellow wasp *Polistes flavus* chromatographed on Sepharose CL-6B column. Absorbance was taken at 640 nm.

3. **Molecular weight determination of wasp venom toxins-** Molecular weight of *Polistes flavus* venom toxins/proteins was determined by Sepharose CL-6B 200 gel column chromatography using standard marker proteins of known molecular weight. A calibration curve was drawn between Ve/Vo log M and with the help of calibration curve range of molecular weight of different protein in the purified yellow wasp *Polistes flavus*

venom was determined. The calibration curve indicates that the molecular weight of purified venom proteins ranging from 14.3-63 kDa (Figure 4).[17]

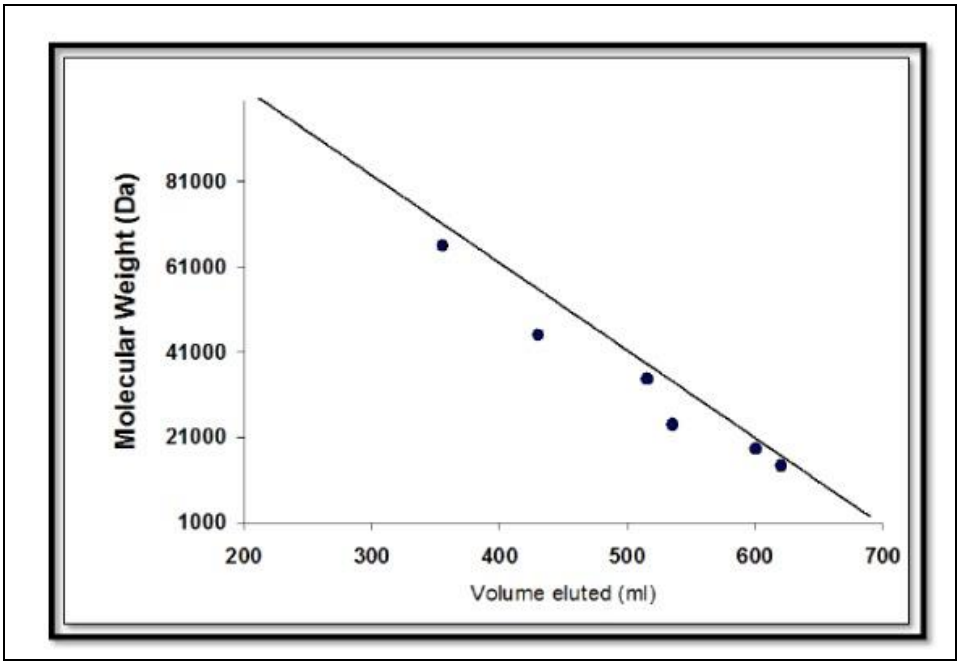

Figure 4: Standard proteins chromatographed on Sepharose CL-6B 200 column for determining the molecular weight of venom proteins/peptides isolated from *Polistes flavus*. Standard proteins used were bovine albumin molecular weight 66,000, egg albumin molecular weight 45,000, pepsin molecular weight 34,700, trypsinogen molecular weight 24,000, beta lactoglobulin molecular weight 18,400 and lysozyme molecular weight 14,300. Elution volumes of unknown proteins were compared with log values on the X-axis for estimation of molecular weights of wasp venom proteins.

4. **Venom toxicity-** The eluted fractions of venom proteins were pooled and lyophilized. The toxicity of the purified wasp venom toxins of the *Polistes flavus* toxin was determined against albino mice (*Mus musculus*). The yellow wasp venom proteins obtained from the lyophilization of the two peaks caused toxicity in the albino mice. The LD_{50} of the yellow wasp *Polistes flavus* venom protein was found 36.11 mg/kilogram body weight i.e., 0.03611 mg/gram body weight of albino mice [19] (Figure 5).

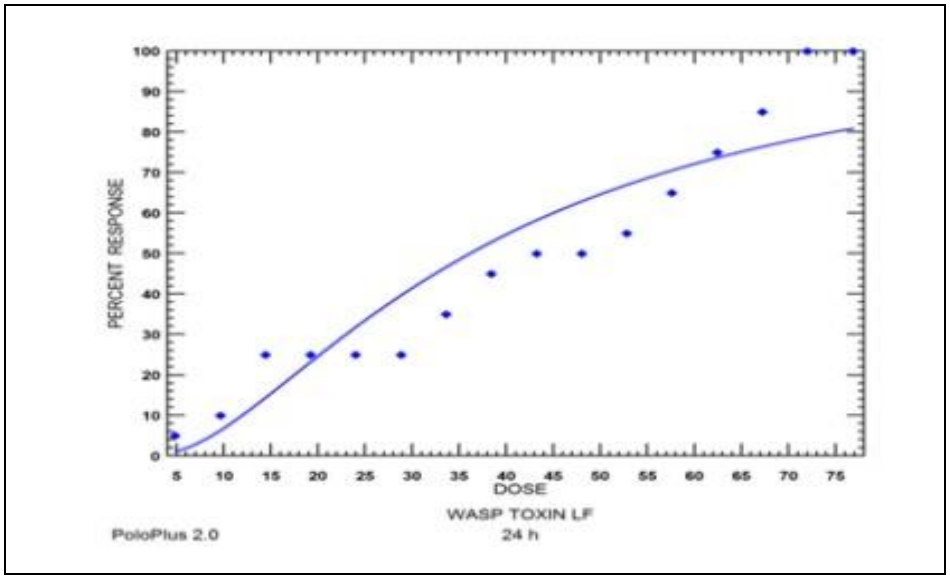

Figure 5: The LD_{50} of the yellow wasp *Polistes flavus* venom protein was found 0.03611 mg/gram body weight of albino mice.

5. **Alteration in glycogen level in the liver, gastrocnemius muscles, auricle and ventricle by purified venom toxins of *Polistes flavus*-** *In vivo* alteration in the level of glycogen were measured in the liver, gastrocnemius muscles and cardiac muscle such as auricle and ventricle of albino mice which were treated with 40% and 80% of 24-h LD_{50} of purified *Polistes flavus* venom. All the tissues were dissected out and glycogen levels in different tissues were measured after 2, 4, 6, 8 and 10 hours of treatment. Wasp venom caused significant ($p>0.05$) decrease in glycogen level in the liver, gastrocnemius muscles, auricle and ventricle of albino mice (Table 1 & 2).

Table 1: *In vivo* effects of 40% of 24-h LD_{50} of purified venom toxins of *Polistes flavus* on the glycogen level of liver, gastrocnemius muscles, auricle and ventricle in the albino mice (*Mus musculus*).

Parameters	Time in hours					
	Control (0)	2	4	6	8	10
Liver	6.00±0.08 (100.0)	5.25±0.08 (87.5)	4.91±0.08 (81.8)	4.50±0.08 (75.0)	4.20±0.08 (70.0)	4.95±0.081 (82.5)
Gastrocnemius muscles	3.90±0.08 (100.0)	3.50±0.08 (89.7)	3.20±0.08 (82.0)	2.90±0.08 (74.3)	2.70±0.08 (69.2)	2.75±0.08 (70.5)
Auricle	3.00±0.08 (100.0)	2.80±0.08 (93.3)	2.61±0.08 (87.0)	2.50±0.08 (83.3)	2.40±0.08 (80.0)	2.80±0.08 (93.3)
Ventricle	3.10±0.08 (100.0)	2.86±0.08 (92.2)	2.61±0.08 (84.1)	2.42±0.08 (78.0)	2.39±0.08 (77.0)	2.81±0.081 (90.6)

Table 2: *In vivo* effects of 80% of 24-h LD_{50} of purified venom toxins of *Polistes flavus* on the glycogen level of liver, gastrocnemius muscles, auricle and ventricle in the albino mice (*Mus musculus*).

Parameters	Time in hours					
	Control (0)	2	4	6	8	10
Liver	6.00±0.081 (100.0)	5.20±0.081 (86.6)	4.50±0.081 (75.0)	4.36±0.081 (72.6)	4.11±0.081 (68.5)	4.60±0.081 (76.6)
Gastrocnemius muscles	3.90±0.081 (100.0)	3.41±0.081 (87.4)	3.09±0.081 (79.2)	2.70±0.081 (69.2)	2.51±0.081 (64.3)	2.80±0.081 (71.7)
Auricle	3.00±0.081 (100.0)	2.90±0.081 (96.6)	2.51±0.081 (83.6)	2.31±0.081 (77.0)	2.20±0.081 (73.3)	2.90±0.081 (96.6)
Ventricle	3.10±0.081 (100.0)	2.65±0.081 (85.4)	2.51±0.081 (80.9)	2.35±0.081 (75.8)	2.11±0.081 (68.0)	2.75±0.081 (88.7)

The liver glycogen level was gradually decreased from normal level and it was reached to 70.0% and 68.5% in albino mice after 8 hour exposure of 40% and 80% of 24-h LD_{50} of treatment. Similarly, glycogen level was increased at 10 hours treatment and which shifted to 82.5% and 76.6% of the control with 40% and 80% of 24-h LD_{50} respectively. These gradually decrease in glycogen level of liver in albino mice shows the time and dose dependent response (Table 1 & 2; Figure 6).

The gastrocnemius muscles glycogen level was gradually decreased from normal level and it was reached to 74.3% and 69.2% in compare to control after 40% and 80% of 24-h LD_{50} in albino mice after 6 hour and gradually decreases up to 69.2% and 64.3% of treatment at 8 hour in compare to control after 40% and 80% of 24-h LD_{50} respectively. While, glycogen level was increased at 10 hours treatment and which shifted to 82.5% and 76.6% with 40% and 80% of 24-h LD_{50} respectively in compare to control. These gradually decrease in glycogen level of liver in albino mice shows the time and dose dependent response (Table 1 & 2; Figure 7).

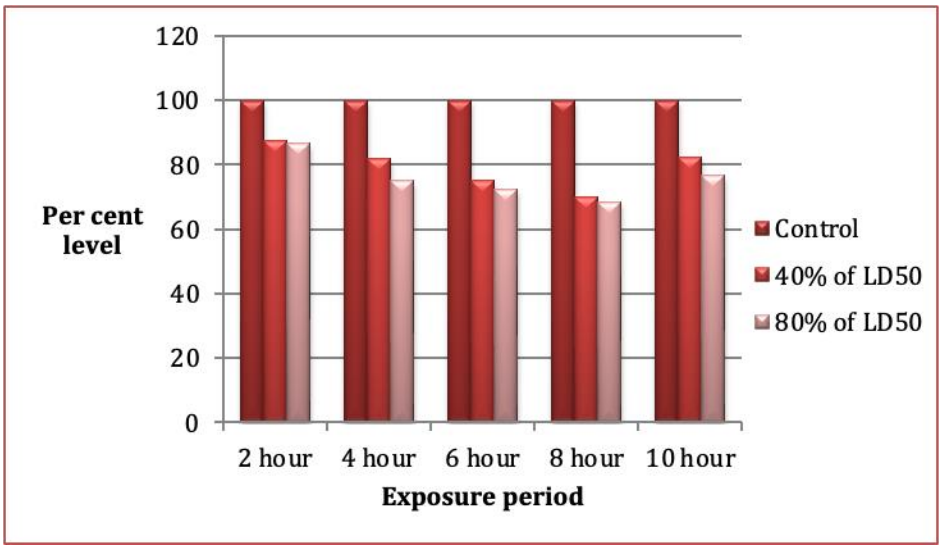

Figure 6: *In vivo* effects of purified venom toxins of *Polistes flavus* on the level of the glycogen content in liver of albino mice with 40% and 80% of 24-h LD_{50}.

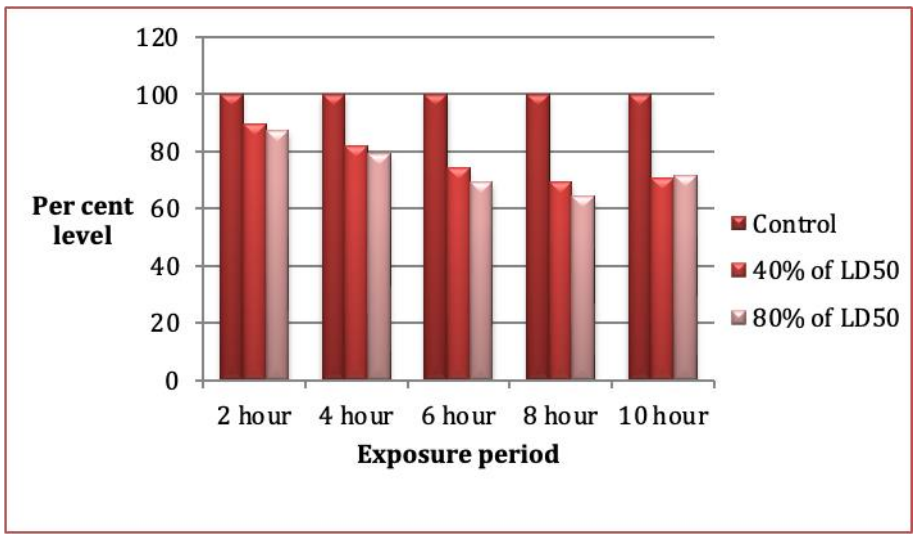

Figure 7: *In vivo* effects of purified venom toxins of *Polistes flavus* on the level of the glycogen content in gastrocnemius muscles of albino mice with 40% and 80% of 24-h LD_{50}.

In cardiac muscle of auricle the glycogen level was gradually decreased from normal level and it was reached to 83.3% and 77.0% of the control after 40% and 80% of 24-h LD_{50} in albino mice after 6 hour and gradually decreases up to 80.0% and 73.3% at 8 hour of treatment in compare to control after 40% and 80% of 24-h LD_{50} respectively. While, glycogen level was increased at 10 hours treatment and which shifted to 93.3% and 96.6% with 40% and 80% of 24-h LD_{50} respectively in compare to control. These gradually decrease

in glycogen level of liver in albino mice shows the time and dose dependent response (Table 1 & 2; Figure 8).

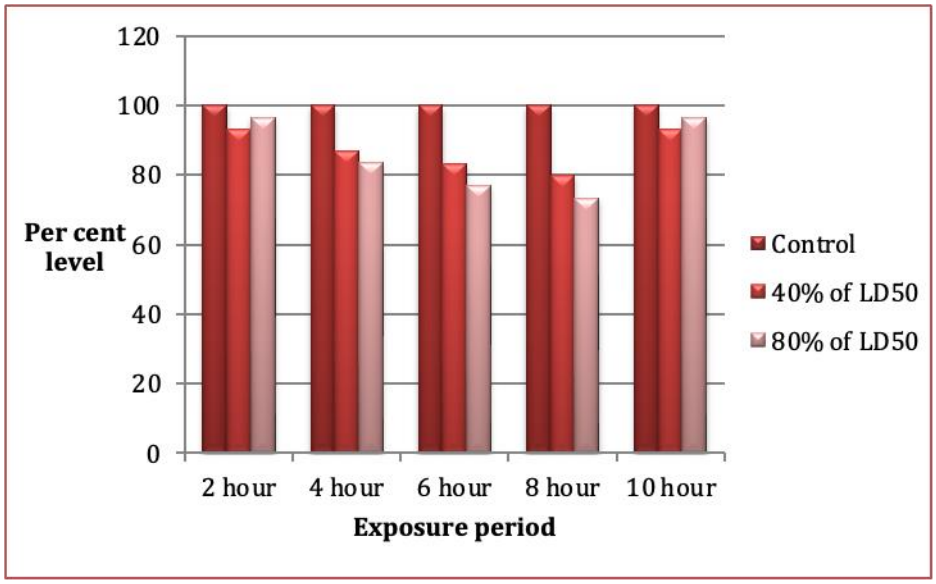

Figure 8: *In vivo* effects of purified venom toxins of *Polistes flavus* on the level of the glycogen content in auricle of albino mice with 40% and 80% of 24-h LD_{50}.

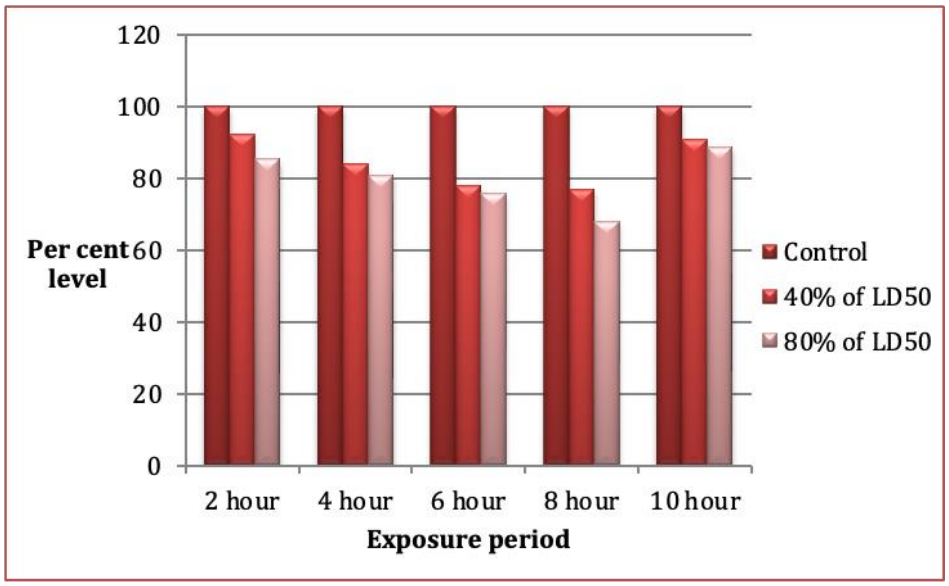

Figure 9: *In vivo* effects of purified venom toxins of *Polistes flavus* on the level of the glycogen content in ventricle of albino mice with 40% and 80% of 24-h LD_{50}.

On the other hand the glycogen level in ventricle of albino mice was gradually decreased from normal level and it was reached to 78.0% and 75.8% of the control after 40% and 80% of 24-h LD_{50} in albino mice after 6 hour and gradually decreases up to 77.0% and 68.0% at 8 hour of treatment in compare to control after 40% and 80% of 24-h LD_{50} respectively. While,

glycogen level was increased at 10 hours treatment and which shifted to 90.6% and 88.7% with 40% and 80% of 24-h LD_{50} respectively in compare to control. These gradually decrease in glycogen level of liver in albino mice shows the time and dose dependent response (Table 1 & 2; Figure 9).

The variation in the glycogen level in liver, gastrocnemius muscles, auricle and ventricle of albino mice after treatment with purified venom toxins of *Polistes flavus* was time and dose dependent ($p<0.05$, f-test, student t-test).

DISCUSSION

In the present investigation *Polistes flavus* venom proteins was isolated and its biological effects on the glycogen level was observed significantly *In vivo* in the body of albino mice *Mus musculus*. First of all, venom toxin was isolated from the venom gland of wasp *Polistes flavus* and purified by gel filtration column chromatography by using Sepharose CL-6B 200 as gel matrix and venom protein were solubilizing in different buffers such as Triton X-100, PBS (50 mM, pH 6.9), 10% TCA, Tris-EDTA and ethyl alcohol. Higher solubilisation was obtained in Triton X-100 (0.1%) (Figure 1).[17] The elution patterns of purified and homogenized sting glands of yellow wasp exhibited two major peaks at 280 nm in the fraction no. 41-61 and fraction no. 81-101. These were pooled in separate tubes (Figure 2). Further concentration and fractionation of venom proteins again revealed two peaks at 640 nm, major one between the fraction no. 46-51 and a major peak between fractions 60-101. Both peaks were eluted with 0.13M NaCl PBS buffer (pH 6.9) and protein estimation was done for each fraction by Lowry´s method.[14] The total yield of protein was 56.23% and specific activity was determined in each fraction (Figure 3). Moreover, molecular weight of wasp *Polistes flavus* venom was also determined on gel filtration chromatography. Venom proteins showed molecular weights ranging from 14.3-63 kDa and shows presence of many peptides as many peaks were observed in chromatograms (Figure 4).

In vivo alteration in the level of glycogen were measured in the liver, gastrocnemius muscles and cardiac muscle such as auricle and ventricle of albino mice which were treated with 40% and 80% of 24-h LD_{50} of purified *Polistes flavus* venom. Liver and muscles are the storable tissue for the glycogen contents in the body carbohydrates, but the venom toxin of wasp were injected in the body of rat, the glycogen level in the body of rat decreases with time and the dose increases it also decreases in the level of glycogen in the liver and muscles of albino mice. The impact of purified wasp venom toxins on glycogen levels liver, gastrocnemius

muscle, auricle and ventricle muscles were investigated and it was found that Wasp venom toxins also caused a significant ($p<0.05$) decreases the level of glycogen liver (68.5%), gastrocnemius muscle (64.3%) at 8th hours, while in cardiac muscles the level of glycogen was 73.3% in auricle and 68.0% in ventricle at 8thhours (Table 2; Figure 6, 7, 8, 9).

The toxin can also induce glycogenolysis in muscles, brain, heart and red blood cells and increases the glucose level in the blood. The glucose broken down by the action of enzymes such as glycogen phosphatase and glycogen debranching enzymes. The first enzymes glycogen phosphatase which catalysed the breaking of α 1$\rightarrow$4 glycosidic linkage and second enzyme opens the branch sites releasing free glucose molecules[18] This is an indication of higher oxidation rate that results in a continuous increase in serum glucose level. This may be due to massive utilization of glucose for removing the toxic stress. Wasp venom toxins inhibit the secretion of insulin, a key enzyme in the regulation of carbohydrate metabolism. However, hyperglycaemia increases the secretion of catecholamine, glucagon, cortisol, thyroid hormone which reduced the less insulin secretion.[19]

The venom protein of wasp targets specific metabolic pathway which activate the biosynthesis of sorbitol and maintain glucose level.[20] Animal requires more oxygen for catabolism, which can only be compensated by the breakdown of blood glucose with subsequent elevation in pyruvic acid, which convert in to acetyl CoA for production of produce more energy in mitochondria. However, to maintain the blood glucose level, glycogenolysis become fast, therefore stored glycogen breaks down.[21] This decrease was attributed to stress hormones such as adrenaline and cortisol, which activate glycogen phosphorylase while inhibiting glycogen synthase.[22] These hormonal changes result in glycogenolysis, the breakdown of glycogen, while inhibiting glycogenesis, the synthesis of glycogen. The reasons behind this may be more glycogenolysis in stored depots i.e. brain, heart, kidney, adipose tissue, and erythrocytes. Another reason might be inhibition of glycogen synthesis due to failure of glucose entrance into the cell through transporters, phosphorylation of glucose to glucose 6-phosphate, isomerization to glucose 1-phosphate, and formation of uridine 5'-diphosphate-glucose, which is the direct glucose donor for glycogen synthesis. Abnormalities in the metabolism of glycogen causes several problems including diabetes, glycogen storage diseases and muscular disorder the enzymes involve in glycogen synthesis or breakdown resulting in either excessive accumulation or insufficient availability of glycogen in cells.[23]

CONCLUSION

The wasp *Polistes flavus* venom protein effects the biochemical changes in the tissue of albino mice. Purified wasp venom toxins after intra-peritoneal administration to albino mice drastically reduced the glycogen levels in various tissues of experimental albino mice, including the liver, gastrocnemius muscle, auricle and ventricle. After injection of the wasp venom protein in the body of albino mice (*Mus musculus*) and measures the changes in the biochemistry of metabolism in liver and muscles and alter the level of glycogen in the liver and muscles of albino mice. The glycogen level observed in decline pattern and the dose of wasp venom induce this alteration in time duration as well as (amount) dose increases also altered glycogen level in the body of albino mice. The venom protein of wasp alter in the level of glycogen in liver and muscles of albino mice which effects the catabolic reaction in the tissue. Wasp stings produce a range of physiological effects that are both anaphylactic and toxic. Stinging by wasps in groups may be fatal to human beings. These attributed to factors such as hormonal control, enzyme activity, inflammation, and oxidative stress.

These toxins encompass a range of enzymes, peptides, and small molecules that can induce substantial alterations in physiological processes and inflict damage on tissues. This study underscores the impact of wasp venom on the histopathological changes in the liver, abdominal muscles, and heart tissues of albino mice, highlighting issues like inflammation, oxidative stress, and metabolic imbalances. Understanding wasp venom components and their interaction with mammalian tissues could enhance our approach to managing envenomation, and potentially lead to the discovery of novel therapeutic applications for venoms.

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CONFLICT OF INTEREST

Authors have no conflict of interest of any type.

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