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**A COMPREHENSIVE THREE (3) MONTHS STUDENTS’ INDUSTRIAL**

**WORK EXPERIENCE SCHEME (SIWES) TECHNICAL REPORT**

**UNDERTAKEN AT**

**THE NATIONAL INSTITUTE FOR PHARMACEUTICAL RESEARCH & DEVELOPMENT (NIPRD) IDU, ABUJA.**

**BY**

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**16/MHS/07/025**

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**COLLEGE OF MEDICAL AND HEALTH SCIENCES**

**COURSE TITLE: STUDENT INDUSTRIAL WORK EXPERIENCE**

**COURSE CODE: PHA 408**

**IN PARTIAL FULFILLMENT FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE (B.Sc.) IN PHARMACOLGY**

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**MAY, 2020**

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**CHAPTER ONE**

**INTRODUCTION**

* 1. **BACKGROUND OF THE SIWES PROGRAMME**
     1. **Introduction**

The students work industrial work experience (SIWES) is an important part of the academic program run by all tertiary institution in Nigeria. It is an accepted skill training program which equips the student practically on their areas specialization as to the theoretical learning aspect.

The program exposed students to the operation and use of equipment, its practical orientate students of their profession, the method and strategy for effective management of the work area. The scheme is a training trip program involving the student, the tertiary institution and relevant organization.

* 1. **HISTORY OF NATIONAL INSTITUTE FOR PHARMACEUTICAL RESEARCH AND DEVELOPEMENT**

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In Nigeria, the need for the advancement of indigenous pharmaceutical research and development (R&D) in order to enhance Development and commercialization of pharmaceutical raw materials, drugs and biological products has long been recognized. Therefore in 1987, the federal Government approved the establishment of the National Institute for Pharmaceutical Research and Development (NIPRD) as a parastatal under the Federal Ministry of Science and Technology. This approval was based on the recommendation of the pharmaceutical society of Nigeria (PSN). The Institute was established under the Science and Technology Act of 1980 with the primary objective of developing drugs, biological products and pharmaceutical raw materials from indigenous resources.

The Pharmaceutical Society of Nigeria (PSN) and the Pharmaceutical Manufacturers Group of the Manufacturers Association of Nigeria (PMG-MAN) made financial contributions toward the take-off of the Institute. A Board of Governors governs the Institute with representations from the PSN, PMG-MAN, Traditional Medicine Practitioners, Federal Ministry of Health (FMH) and Federal Ministry of Science and Technology (FMST) while the Chief Executive serves as member and Secretary to the Board.

The first major activity of the Institute was the organization of an International Workshop on “Strategies and Priorities for Indigenous Pharmaceutical Research and Development” in October 1989. The proceedings of the workshop were published in 1991. In 1990, the Institute embarked on the documentation of medicinal and aromatic plants within the Federal Capital Territory (FCT) of the Federal Republic of Nigeria. The data accumulated during the enthnobotanical survey are being compiled into a National compendium of medicinal and aromatic plants in Nigeria

**CHAPTER TWO**

**DESCRIPTION OF WORKDONE**

**2.1 ANIMAL HANDLING AND RESTRAINT**

For the safety of the handler and the animal, proper methods for handling and restraining laboratory animals should be followed. Training in handling techniques are provided to enable the inexperienced handler to gain confidence and skill. Improper handling can result in increased stress and injury to the animal. In addition, the handler risks injury from bite wounds or scratches inflicted when the animal becomes fearful and anxious. By using sure, direct movements with a determined attitude, the animal can be easily handled and restrained.

Animals can be restrained either manually or in a plastic restrainer. I was taught how to handle animals like mice, rats and rabbits.

* + 1. **BLOOD COLLECTION**

Collecting blood from mice or rat is necessary for a wide variety of scientific studies, and there are a number of efficient methods available. It is important to remember that blood collection, because it can stress the animals, may have an impact on the outcome of research data. In addition, it is extremely important that those who collect blood become skilled in the techniques they employ, and seek to stress the animal as little as possible.

* 1. **TOXICOLOGICAL TEST**
     1. ***Acute Toxicity Test (LD50)***

The assessment of the lethal dose (LD50) (the dose that kills 50% of test animals population) has now been used as a major parameter in measuring acute toxicity and also as an initial procedure for general screening of chemical and pharmacological agents for toxicity. Apart from mortality, other biological effects and the time of onset, duration and degree of recovery on survived animals, are also important in acute toxicity evaluation.

***Procedure***

This method has two phases which are phases 1 and 2 respectively.

***Phase 1***

This phase requires nine animals. The nine animals are divided into three groups of three animals each. Each group of animals are administered different doses (10, 100 and 1000 mg/kg) of test substance. The animals are placed under observation for the first two critical hours after dosing and subsequently for 24 hours to monitor their behavior as well as if mortality will occur. If mortality occurs, a lower range of doses is selected for the second phase

***Phase 2***

This phase involves the use of three animals, which are distributed into three groups of one animal each. The animals are administered higher doses (1600, 2900 and 5000 mg/kg) of test substance and then observed for 24 hours for behavior as well as mortality. Then the LD50 is calculated by the formula:

*LD50 =√maximum dose for all survival × minimum dose for all death. (Lorke 1983)*

* 1. **MOTOR COORDINATION AND BALANCE IN RODENTS**

Measurement of motor coordination and balance can be used not only to assess the effects of test compounds or other experimental manipulations on mice and rats, but also to characterize the motor phenotype of transgenic or knockout animals. Two well-established and widely used prot0ocols for measuring motor coordination and balance in mice and rats are;

* Rota-rod Test
* Inclined Plana Test
  + 1. ***Assessing Balance Using a Rotarod Test***

***Principle***

The rotarod is used to assess the ability of an animal to balance on a rotating rod. The latency to fall off the rotating rod is measured and used as an indication of motor coordination and balance. As the speed of rotation is increased, it becomes more difficult for the animal to keep its balance. Records of either the maximum speed at which the animal can stay on for a given duration (e.g., 30 sec) or the time it takes the animal to fall at a range of different speeds are taken.

***Materials***

* Male or female mice
* 70% (v/v) ethanol
* Rota-rod apparatus with appropriate rotating cylinder for mice (diameter ∼30 mm) or rats (diameter ∼70 mm)

***Procedure***

***Train subjects***

1. Transfer male or female mice, in their home cages, from the holding room to the experimental room. Allow mice to habituate to the experimental room for 60 min.

*The experimental-room environment should be kept constant between test sessions with respect to temperature, humidity, and light intensity.*

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1. Start the rotarod apparatus turning and allow it to revolve at a consistent speed.

*An initial intermediate speed of 24 rpm is recommended.*

1. Place each mouse individually on the rotating rod for a maximum of 60 sec. Record the latency to fall off the rotarod within this time period.
2. Return mice to their home cages between trials, allowing a 5- to 10-min inter-trial interval.
3. Give mice four trials per day for three consecutive days.

*After this training period, most mice attain a stable baseline level of performance. If this is not achieved, training can be continued for an additional 2 or 3 days*

1. At the end of each day’s training session, return all mice to the holding room, turn off the rotarod, and clean the apparatus thoroughly with 70% ethanol.

*Mice often urinate and defecate while on the rotarod. Urine and feces on a rod can impair the performance of the mouse being tested. It is therefore important to clean the apparatus frequently.*

***Test subjects***

1. Transfer mice, in their home cages, from the holding room to the experimental room. Allow mice to habituate to the experimental room for 60 min.
2. Turn the rotarod on and calibrate the rotarod so that it revolves at several different predefined speeds.
3. Give mice two trials at each predefined speed level as described in steps 3 and 4.

*If animals are impaired on the rotarod, use fewer speed levels (omitting the fastest speeds first) and longer inter-trial intervals for testing.*

1. At the end of the testing session, return mice to the holding room, turn off the rotarod, and thoroughly clean the apparatus with 70% ethanol.

***Results***

The mean latency to fall for the two trials at each speed level, for each mouse, is analyzed. Any mouse that stays on the rod for the full 60-sec trial is allocated a maximum value of60 sec for analysis.

* + 1. ***Accessing Motor Coordination and Balance Using Inclined Plane***

***Principle***

The plane consists of two rectangular plywood boards connected at one end by a hinge. One board is the base; the other is the movable inclined plane. Two plywood side panels with degrees marked on their surface are fixed on the base. It is used for testing compounds for muscle relaxant activity. The principle of an inclined plane has been used by Ther, Vogel and Werner (1959) for differentiating neuroleptics from other centrally active drugs. Rivlin and Tator (1977) also used an inclined plane to assess skeletal muscle relaxation.

***Materials***

* 20- to 30-g male mice
* Treatment solutions: drug or test compound, reference compound, and vehicle alone (for control)
* Incline Plane apparatus
* Stop watch
* Metric balance (e.g., Sartorius type 1401.001), accurate to 0.1 g
* 1-ml syringes and needles for intraperitoneal and subcutaneous injections
* Gastric probes with oval extremity for oral administration

***Procedure***

1. House mice (10 per cage) in cages containing wood shavings. Provide free access to standard rodent diet and tap water, and maintain a controlled temperature of 21◦ ± 3◦C and a standard (non-reversed) light/dark cycle with illumination from 0700 to 1900. Use five groups of ten mice per group for a standard experiment (vehicle control, reference compound, and three doses of test substance).
2. Place the animals in the experimental room at least 60 min before the beginning of the experiment, and immediately weigh and code the animals with indelible ink.
3. Administer the appropriate treatment in a volume of 10 ml/kg. Wait a predetermined time after administration to begin the test, usually 30 min for intra-peritoneal and subcutaneous injections, and 60 min for oral administration.
4. Place animal (60 by 122 cm) inclined at a fixed angle (beginning at 45 degree).
5. Each animal is placed onto the surface facing the upper edge of the rectangular plywood plane at a distance of approximately 10 cm from the top and is then released after a 5 sec delay allowing for stable footing.
6. If an animal did not freely slide backward within 30 sec the trial is scored as a success and the animal is returned to its holding cage.
7. An animal is given a maximum of four trials at any given angle. The angle of inclination is then increased by 1 degree and the procedure repeated following a rest period of at least 5 min.
8. Testing is discontinued if no success is scored two consecutives angle of inclination (i.e., eight consecutive falls).
9. Angle of first fall, total number of falls, and threshold angle (defined as the last angle at which the animal succeeded at least once) is then determined for each subject

***Results***

Compare data from treated groups with data from the control group using analysis of variance followed by post hoc tests. The peak time is determined as the time at which a compound produces the maximum performance deficit. At this time interval, a range of doses is tested using 10 animals per group. *ED*50 values are calculated.

* 1. **TEST OF DEPRESSION**
     1. ***Forced Swim (Behavioral Despair) Test in the Mouse***

***Principle***

Rodents forced to swim in a narrow space from which there is no escape adopt, after an initial period of vigorous activity, a characteristic immobile posture, moving only when necessary to keep their heads above the water. The animals’ immobility was interpreted as indicating they had learned that escape was impossible and had adopted an immobile position to conserve energy, viewed anthropomorphically as if they had given hope of escaping from this stressful situation. Immobility was therefore given the name “behavioral despair.” It was subsequently found that immobility could be reduced by a wide range of clinically active antidepressants. This simple behavioral procedure has since become a useful test for screening novel antidepressants

***Materials***

* 20- to 25-g male mice
* Treatment solutions: drug or test compound, reference compound (e.g.,imipramine hydrochloride, Sigma or equivalent), and vehicle alone (for control)
* Transparent Plexiglas cylinders (13 cm diameter × 24 cm high) containing water (22◦C ± 2◦C) to a depth of about 10 cm
* Opaque screens for separating cylinders
* Metric balance (e.g., Sartorius type 1401.001), accurate to 0.1 g
* 1-ml syringes and needles for intraperitoneal and subcutaneous injections
* Gastric probes with oval extremity for oral administration

***Procedure***

In two sessions separated by 24 hr, mice are forced to swim in a narrow cylinder from which they cannot escape. The first session, lasting 15 min, is conducted prior to drug administration and without behavioral recording. This is done to acclimate the mice to the test situation, thereby providing a stable, high level of immobile behavior during the 5-min test session 24 hr later.

1. House mice (10 per cage) in cages containing wood shavings. Provide free access to standard rodent diet and tap water, and maintain a controlled temperature of 21◦ ± 3◦C and a standard (non-reversed) light/dark cycle with illumination from 0700 to 1900. Use five groups of ten mice per group for a standard experiment (vehicle control, reference compound, and three doses of test substance).
2. Set up two transparent cylinders separated visually from one another by an opaque screen.
3. Place the animals in the experimental room at least 60 min before the beginning of the experiment, and immediately weigh and code the animals with indelible ink. Make food and water available throughout the experiment.
4. Administer the appropriate treatment in a volume of 10 ml/kg. Wait a predetermined time after administration to begin the test, usually 30 min for intraperitoneal and subcutaneous injections, and 60 min for oral administration.

*The test should be performed blind with coded solutions to avoid bias in evaluating the animal behavior.*

1. Place two animals simultaneously in individual side-by-side cylinders separated by an opaque screen. Measure the latency to immobility from the start of the test and the duration of immobility for the last 4 min of the 6-min test session.

*The latency to immobility corresponds to the delay between the start of the test and appearance of the first bout of immobility, defined as a period of at least 1 sec without any active escape behavior.*

1. Score the duration of immobility by summing the time spent immobile (i.e., the time not spent actively exploring the cylinder or trying to escape from it); score as immobile minor movements strictly necessary to maintain the animal’s head above water.

*The same observer can score the behavior of two animals simultaneously. The first 2 min of the session are useful for preparing other animals.*

***Results***

Compare data from treated groups with data from the control group using non-paired Student *t* tests (two tailed). Other statistical evaluations (e.g., analysis of variance followed by post hoc tests) can also be used.

* + 1. ***Tail Suspension Test in the Mouse***

***Principle***

The tail suspension test in mice is conceptually similar to the forced swim test, but differs in that immobility is induced by suspending the animal by its tail. A mouse will initially try to escape from tail suspension by engaging in vigorous movements and then, after a few minutes, become immobile. In a manner analogous to the forced swim test, immobility is reduced by a wide variety of antidepressants.

***Materials***

* 20- to 25-g male mice
* Standard rodent diet
* Treatment solutions: drug or test compound, reference compounds (e.g., imipramine hydrochloride and diazepam), and vehicle alone (for control)
* Tail suspension apparatus (20 cm × 25 cm × 30 cm) fitted with a ceiling hook
* Metric balance (accurate to 0.1 g)
* 1-ml syringes and needles for intra-peritoneal and subcutaneous injections
* Gastric probes with oval extremity for oral administration
* Stopwatches

***Procedures***

1. House mice (10 per cage) in cages containing wood shavings, and provide free access to standard rodent diet and tap water. Maintain a controlled temperature of 21◦ ±3◦C and a standard (non-reversed) light/dark cycle with illumination from 0700 to 1900. Use six groups of ten mice per group for a standard experiment (vehicle control, two reference compounds, and three doses of test substance).
2. Place the animals in the experimental room at least 60 min before the beginning of the experiment, and immediately weigh and code the animals with indelible ink. Remove food and water for the duration of the test.
3. Administer the appropriate treatment in a volume of 10 ml/kg. Wait a predetermined time after administration to begin the test, usually 30 min for intra-peritoneal and subcutaneous injections, and 60 min for oral administration.

*The test should be performed blind with coded solutions to avoid bias in evaluating animal behavior. Drug and test substance treatments should be administered to individual animals in a fixed rotation (A, B, C), to ensure a regular distribution of the different treatments over time.*

1. Wrap adhesive tape around the animal’s tail in a constant position three quarters of the distance from the base of the tail. To avoid injury, suspend the animals by passing the suspension hook through the adhesive tape as close as possible to the tail (1 to 2 mm) to ensure the animal hangs with its tail in a straight line.

*The same observer can comfortably monitor two animals simultaneously. The animals should be visually shielded from one another during the test.*

1. Observe the animals continuously for 6 min. Use separate stopwatches for each animal and sum the time spent immobile by each over the 6-min observation period.

***Results***

Compare data from treated groups with data from the control group using non-paired Student *t* tests. Other statistical evaluations (e.g., analysis of variance followed by post hoc tests) can also be used.

* 1. **TEST FOR ANXIETY**

There are lots of widely used tests to evaluate fear and anxious behaviour in rodents, among such are;

1. Open field (OF),
2. Elevated Plus Maze (EPM)
3. Light/Dark Box
4. Zero Maze Test.

The models are simple and it has been argued that different environments give different behavior profiles and measure different kind of behavior

* + 1. ***Elevated Plus-Maze Test***

***Principle***

This assay essentially relies on the inherent conflict between a comparatively safe and comfortable environment (the closed arms) and a risky environment (elevated open spaces). It is often discussed in terms of avoidance or fear and is technically a preference test – one portion of the arm is avoided only in comparison to the other portion. The general principle is that the more “anxious” the subjects are, the less likely they will be to explore an uncomfortable, risky, or threatening environment. Thus, previous stress, presence of a predator odor, previous handling, manipulation of stress hormones and peptides all effect behavior in the EPM. Unfortunately, not all these factors produce the same effects in each strain, sex, age species etc.



***Materials***

* Male or female rats or mice
* Quiet test room away from disturbance
* Stop watches
* Elevated plus-maze apparatus
* Counter for scoring behaviors
* Treatment solutions: drug or test compound, reference compound, and vehicle alone (for control)
* 70% Alcohol
* Cotton wool
* Metric balance (e.g., Sartorius type 1401.001), accurate to 0.1 g
* 1-ml syringes and needles for intraperitoneal and subcutaneous injections
* Gastric probes with oval extremity for oral administration

***Procedures***

1. Set up the plus maze in the test room

*The test room should have few features or contents, as these influence open-arm behavior.*

*If the maze is too low and the mice can clearly see the ground, they will simply jump off the apparatus.*

1. Randomly allocate animals to the various drug groups and inject them at the interval appropriate to the route of injection of a particular drug. At least 1 hr before the test, bring the animal to a holding area immediately adjacent to the test room. Keep the holding area quiet.
2. Place the animal in the central platform, facing an open arm. Observe the animal for 5 min.

*Test sessions >5 min can produce very different results, particularly with respect to second-trial performance.*

*Test animals* **once only***, unless the intention is specifically to study the different form of anxiety evoked by a second trial. If the animal falls off, it is best to exclude its scores.*

1. Use a strict definition of an arm entry (all four paws must enter the arm) and arm exit (both forepaws must leave the arm). Measure the following:

* Number of entries into open arms;
* Number of entries into closed arms;
* Time spent in open arms;
* Time spent in closed arms;
* Time spent in the central square.

The following optional measures may also provide useful information:

* Number of rears (these occur almost exclusively in the closed arms);
* Entries into distal portion of open arms;
* Head-dipping over sides of open arms;
* Stretch-attend, scanning, flat-back posture.

1. Remove the animal and any feces, wipe the maze with a cotton wool soaked in 70% alcohol and allow to dry.

*Avoid using strong-smelling detergent.*

***Results***

Anxiolytic drugs or treatments should increase the percentage of time spent on the open arms and the percentage of entries onto the open arms; anxiogenic treatments should decrease these measures. If the number of closed-arm entries also changes, use this measure in analysis of covariance with percent time spent on the open arms to determine the specificity of an anxiolytic or anxiogenic effect.

* + 1. ***Light/Dark Exploration Test***

***Principle.***

The light/dark exploration test uses the ethological conflict between the tendencies of mice to explore a novel environment and to avoid a brightly lit, open area. Anxiolytic drugs increase the number of transitions between the light and dark compartments and non-anxiolytics do not. The number DBV of transitions is highly correlated with other exploratory behaviors and is not correlated with locomotor activity in an undifferentiated open field.

***Materials***

* Male mice of appropriate strain group housed
* Drugs to be tested Saline or vehicle for control injections
* Quiet, darkened test room away from disturbance
* Illuminated test chamber, screened from observers

***Procedures***

1. Group house the mice at a constant temperature of 21oC with food and water freely available.
2. Bring mice into test room at least 1 hr before testing and protect from external perturbation.

*Test the mice in the morning for standard light cycle, or in the afternoon, for reversed cycle. Standardize the time of testing to minimize diurnal variation.*

1. Administer mice with drug or vehicle and immediately replace in holding cage.

*The interval between injection and test depends on the compound and route of injection.*

*Allow at least 10 min to minimize stressful effects of injection.*

1. Place mice individually in the middle of the illuminated chamber, facing away from the opening. Allow 5 or 10 min of free exploration and count the number of crossings from the white to the black side, the time spent on each side, and the latency period before first leaving the white side.

*Additional measures of the activity on each side are optional. The observer must not know*

*the drug treatment status of the mouse.*

1. Remove any feces, wipe up urine, and wipe down the box with 70% alcohol after each trial.

*Avoid using strong-smelling detergent.*

***Results/Discussion***

Crawley has found that the number of transitions between the black and white sides is the best measure in this test, being highly correlated with other exploratory behaviors and not correlated with locomotor activity in an undifferentiated open field (Crawley, 1981), and that this paradigm is more sensitive to the detection of anxiolytics than anxiogenics. Costall et al. (1989) has found that the latency to leave the white side and time spent on this side are more reliable measures, and her procedure can detect the effects of anxiogenic treatments. A major problem with this test is distinguishing between specific and nonspecific changes in activity; this differentiation is best accomplished by performing parallel experiments that provides independent measures of locomotor activity and rearing (File and Wardill, 1975).

The most important cause of difficulty is the strain of mouse. While this factor may appear to be a practical limitation, it also provides an opportunity for genetic studies of anxiety in this test situation. The most likely other cause of problems comes from the white side being insufficiently aversive, the most important feature being the light level differential between the two sides. The light level in the animal facility is an important contributor, and lower light levels of housing will enhance the response in this test.

* + 1. ***Open Field Test***

***Principle***

The open field (OF) test is a measure of emotional behavior in rodent. It provides a unique opportunity to systematically assess novel environment exploration, general locomotor activity, and provides an initial screening for anxiety related behavior in rodents. The OF is influenced by social isolation resulting from physical separation of mouse from its cage mates and factor due to the stress created by the brightly lit, unprotected novel test environment (Landgraf and Wigger, 2002; Prut and Belzung, 2003). The number of line crossings, total distance travelled and rearing are measure of anxiety and overall exploratory/locomotor activity. A high frequency of these variables indicates a less emotional mice behavior

***Materials***

* Male and female mice of appropriate strain group housed
* Drugs to be tested Saline or vehicle for control injections
* Quiet, darkened test room away from disturbance
* Illuminated test chamber, screened from observers
* Stop watch

***Procedure***

1. Set up the open field apparatus in the test room

*The test room should have few features or contents, as these influence behavior.*

1. House mice (10 per cage) in cages containing wood shavings. Provide free access to standard rodent diet and tap water, and maintain a controlled temperature of 21◦ ± 3◦C and a standard (non-reversed) light/dark cycle with illumination from 0700 to 1900. Use five groups of six mice per group for a standard experiment (vehicle control, reference compound, and three doses of test substance).
2. Place the animals in the experimental room at least 60 min before the beginning of the experiment, and immediately weigh and code the animals with indelible ink.
3. Randomly allocate animals to the various drug groups and inject them at the interval appropriate to the route of injection of a particular drug. At least 1 hr before the test, bring the animal to a holding area immediately adjacent to the test room. Keep the holding area quiet.
4. Place the Mice at one of the four corners of the open field and allowed to explore the apparatus for 5 minutes.
5. The scoring behaviours (Brown et al, 1999) include:
   1. Line Crossing: Frequency with which the mice cross one of the grid lines with all four paws.
   2. Centre Square Entries: Frequency with which the mice cross one of the lines with all four paws into the central square.
   3. Centre Square Duration: Duration of time the mice spent in the central square.
   4. Rearing: Frequency with which the mice stand on their hind legs in the maze.
   5. Stretch Attend Postures: Frequency with which the animal demonstrates forward elongation of the head and shoulders followed by retraction to the original position.
   6. Grooming: Duration of time the animal spent licking or scratching itself while stationary.
   7. Freezing: Duration with which the mouse is completely stationary.
   8. Urination: number of puddles or streaks of urine.
   9. Defecation: number of fecalboli produced.
6. After the 5 minute test, mice are returned in their home cages and the open field is then cleansed with 70 % alcohol and permitted to dry between tests.

***Results/Discussion***

The Open Field Test provides simultaneous measures of locomotion, exploration and anxiety. The number of line crosses and the frequency of rearing are usually used as measures of locomotor activity, but are also measures of exploration and anxiety. A high frequency of these behaviours indicates increased locomotion and exploration and/or a lower level of anxiety. The number of central square entries and the duration of time spent in the central square are measures of exploratory behaviour and anxiety. A high frequency/duration of these behaviours indicates high exploratory behaviour and low anxiety levels.

Stretch attend postures are “risk-assessment” behaviors which indicate that the animal is hesitant to move from its present location to a new position and thus a high frequency of these postures indicates a higher level of anxiety. Grooming behavior is a displacement response and is expected to be displayed in a novel environment. Therefore grooming behavior should decrease with repeated exposure to the testing apparatus. Defecation and urination are often used as measures of anxiety, but the validity of defecation as a measure of anxiety has been questioned (Lister, 1990). Hall (1934) describes defecation and urination as indices of anxiety in rodents. He argues that the animal will have reduced locomotion in a novel environment but the autonomic nervous system will be activated which will increase defecation in this noxious arena. However, Bindra& Thompson (1953) argue that there is no significant relation between fearfulness and urination and defecation as measured in the Open Field test. Nevertheless, it is generally agreed that defecation and urination in a novel environment are signs of emotionality, which is not to be equated with fearfulness or timidity.

**CHAPTER THREE**

**CONCLUSION**

* 1. **SUMMARY AND EXPERIENCE GAINED**

The importance of students industrial work experience (SIWES) cannot be overemphasized.Throughout my stay in National Institute for Pharmaceutical Research and Development(NIPRD), I was dully equipped with practical aspect of my field of study and as well as the very bases of research skills in pharmaceutics. NIPRD is not just a place of industrial attachment but a school on its own, which exposes students to their field of studies in more practical terms and also provides an avenue for students to get exposed to modern scientific equipment used in research work and how to handle them.

* 1. **RECOMMENDATION**

I would like to make the following recommendations:

* It is advisable that the institution or university should assist students in the selection of the best establishment for placement, on the part of the students; they are expected to select an establishment that will tally with their field of studies.
* Students on industrial attachment should be closely supervised by school and their industrial based supervisor in order to ensure that the code of conduct of SIWES is not defeated.
* Finally, I wish to strongly recommend National Institute for Pharmaceutical Research and Development for students interested in research to undertake their SIWES training there.