"Subchronic Delayed Neurotoxicity of Organophosphorus Substances: 90-day Study"

1. **INTRODUCTORY INFORMATION**

- **Prerequisites**
  - Solid or liquid test substance
  - Chemical identification of test substance
  - Purity (impurities) of test substance
  - Solubility characteristics
  - Stability of test substance
  - Melting point/boiling point
  - pH (where appropriate)

- **Standard documents**

  There are no relevant international standards.

2. **METHOD**

A. **INTRODUCTION, PURPOSE, SCOPE, RELEVANCE, APPLICATION AND LIMITS OF TEST**

In the assessment and evaluation of the toxic characteristics of organophosphorus substances, the determination of subchronic delayed neurotoxicity may be carried out, usually after initial information on delayed neurotoxicity has been obtained, by acute testing or by the demonstration of inhibition and ageing of neurotoxic esterase in hen neural tissue. The subchronic delayed neurotoxicity test provides information on possible health hazards likely to arise from repeated exposures over a limited period of time. It will provide information on dose response and can provide an estimate of a no-effect level which can be of use for establishing safety criteria for exposure.

- **Definitions**

  **Subchronic delayed neurotoxicity** is a prolonged, delayed-onset locomotor ataxia resulting from repeated daily administration of the test substance.
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- **Reference substances**

  If a positive control is used, a substance which is known to produce delayed neurotoxicity should be employed. Examples of such substances are triorthocresyl phosphate (TOCP) and leptophos.

- **Principle of the test method**

  Multiple dose levels of the test substance are administered orally to domestic hens (Gallus gallus domesticus) for 90 days. The animals are observed at least daily for behavioural abnormalities, locomotor ataxia and paralysis. Histopathological examination of selected neural tissues is undertaken at the termination of the test period.

B. **DESCRIPTION OF THE TEST PROCEDURE**

- **Preparations**

  Healthy young adult hens free from interfering viral diseases and medication and without abnormalities of gait should be acclimatised to the laboratory conditions for at least five days prior to randomisation and assignment to treatment and control groups.

- **Experimental animals**

  **Selection of species**

  The adult domestic laying hen, aged between 8-14 months, is recommended. Standard size breeds and strains should be employed.

  **Number**

  Ten hens should be used for each treatment and control group.

  **Controls**

  A concurrent control group should be used. This group should be treated in a manner identical to the treated group, except that administration of the test substance is omitted.
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**Housing and feeding conditions**

Cages or enclosures which are large enough to permit free mobility of the hens and easy observation of gait should be used. Where the lighting is artificial, the sequence should be 12 hours light, 12 hours dark. Appropriate diets should be administered as well as an unlimited supply of drinking water.

- **Test conditions**

  **Dose levels**

  At least three dose levels should be used in addition to the control group(s). The highest dose level should result in toxic effects, preferably delayed neurotoxicity, but not produce an incidence of fatalities which would prevent a meaningful evaluation. The lowest dose level should not produce any evidence of toxicity.

  **Route of administration**

  Oral dosing each day for at least five days per week should be carried out, preferably by gavage or administration of gelatine capsules.

- **Procedure**

  The test or control substance should be administered and observations begun. All hens should be carefully observed at least once daily throughout the test period. Signs of toxicity should be recorded, including the time of onset, degree and duration. Observations should include, but not be limited to, behavioural abnormality, locomotor ataxia and paralysis. At least once a week the hens should be taken outside the cages and subjected to a period of forced motor activity, such as ladder climbing, in order to enhance the observation of minimal responses. The hens should be weighed weekly. Any moribund hens should be removed and sacrificed.
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- **Pathology**

  **Gross necropsy**

  In the presence of clinical signs of delayed neurotoxicity, useful information may be provided by gross necropsy.

  **Histopathology**

  Tissues from all animals should be fixed *in situ*, using perfusion techniques. Sections should include medulla oblongata, spinal cord and peripheral nerves. The spinal cord sections should be taken from the upper cervical bulb, the mid-thoracic and lumbo-sacral regions. Sections of the proximal region of the tibial nerve and its branches and of the sciatic nerve should be taken. Sections should be stained with appropriate myelin and axon-specific stains. Microscopic examination should be carried out on all hens in the control and high-dose groups. Microscopic examination should also be carried out on hens in the low and intermediate dose groups when there is evidence of effects in the high-dose group.

3. **Data and Reporting**

- **Treatment of results**

  Data may be summarised in tabular form, showing for each test group the number of animals at the start of the test, the number of animals showing lesions or effects, the types of lesions or effects, and the percentage of animals displaying each type of lesion or effect.

  All observed results should be evaluated by an appropriate statistical method. Any generally accepted statistical method may be used; the statistical methods should be selected during the design of the study.

- **Evaluation of results**

  The findings of a subchronic delayed neurotoxicity study should be evaluated in conjunction with the findings of preceding studies and considered in terms of the incidence and severity of observed neurotoxic effects and any other observed effects and histopathological findings in the treated and control groups. A properly conducted subchronic test should provide
a satisfactory estimation of a no-effect level based on lack of clinical signs and histopathological changes.

- **Test report**
  
  The test report should also include the following information:
  
  - doses administered (mg/kg);
  - toxic response data by group with a description of clinical manifestations of nervous system damage; where a grading system is used the criteria should be defined;
  - time of death during the study or whether animals survived to termination;
  - the day of observation of each abnormal sign and its subsequent course;
  - body weight data;
  - necropsy findings for each animal, when performed;
  - a detailed description of all histopathological findings; and
  - statistical treatment of results.

- **Interpretation of results**
  
  This study provides information on the neurotoxic effects of repeated exposure to organophosphorus substances. Extrapolation from the results of the study to man is valid only to a limited degree, although it can provide useful information on the degree of neurotoxic activity of a substance, no-effect levels and permissable human exposure.

4. **Literature**

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