One Health (OH) Concept on the Assessment of *In-Vivo* Antiparasitic Activity of Nerolidol Against the Growth and Survival of Zoonotic Haemoflagellate Protozoa, *Trypanosoma evansi*

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One Health (OH) Concept

- Recognizes interrelationship between animal, human and environmental health, locally and globally.

- Holistically embraces a very broad scope: biodiversity, rural development, food security, ecosystem sustainability, policy issues, wildlife diseases, etc..

- Initiate worldwide strategies for interdisciplinary collaboration & communication in all aspect of healthcare and services

- Everyone involved in OH could identify their specific role within it
Trypanosomiasis

- Vector borne → haemoflagellate & unicellular protozoa
  - *T. b. gambiense* → chronic HAT
  - *T. b. rhodesiense* → acute HAT
  - *T. cruzi* → Chagas disease

- Atypical human trypanosomiasis:
  - *T. vivax* → nagana (cattle & wild)
  - *T. lewisi* → *Rattus* & other rodents
  - *T. congolense* → nagana (camels, dogs, horses, pigs, ruminants)
  - *T. evansi* → surra (mammals)
# Atypical Human Trypanosomiasis (aHT) (Philippe et al. 2013)

<table>
<thead>
<tr>
<th>Patient Number</th>
<th>Location</th>
<th>Trypanosome Species/Subspecies</th>
<th>Date</th>
<th>Parasite Identification Method(^a)</th>
<th>Fever</th>
<th>Treatment</th>
<th>Outcome</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Ghana</td>
<td>T. vivax</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
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<td>1930(^b)</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td>3</td>
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<td>ND</td>
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<td>6</td>
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<td>T. congolesne</td>
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<td>Pentamidine</td>
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<td>Atoxyl</td>
<td>Cure</td>
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<td>8</td>
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<td>1999</td>
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<td>None</td>
<td>Self-Cure</td>
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<tr>
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<td>T. evansi</td>
<td>2004</td>
<td>PCR</td>
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<td>Suramin</td>
<td>Cure</td>
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<td>Death</td>
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<td>Present</td>
<td>ND</td>
<td>Cure</td>
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<td>T. lewisi</td>
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<td>Melarsoprol</td>
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<td>Cure</td>
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<td>17</td>
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<td>None</td>
<td>Self-cure</td>
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<td>18</td>
<td>India, Pune</td>
<td>T. lewisi</td>
<td>2007</td>
<td>PCR</td>
<td>Present</td>
<td>Suramine</td>
<td>Death</td>
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<tr>
<td>19</td>
<td>India, Bagpat</td>
<td>T. lewisi</td>
<td>2010</td>
<td>PCR/S</td>
<td>Present</td>
<td>Pentamidine</td>
<td>Cure</td>
</tr>
</tbody>
</table>
Trypanosoma evansi

- Animal haemoflagellated protozoa → evolutionarily from *T. brucei*
- 1st discovered in 1880 by Sir Griffith Evans in Punjab, India
- Malaysia in 1903 → cow & sheep migration from Thailand
- Atypical human trypanosomiasis (aHT) → 5 human zoonotic cases in India, Egypt and Sri Lanka
- Bad impact & challenges on both human and veterinary medicine
INTRODUCTION

Vectors of Trypanosomiasis

- Triatominae bug
- Glossinidae fly
- Hirudinae / leech
- Desmodontinae / vampire bat
INTRODUCTION

Vectors of Atypical Human Trypanosomiasis (aHT)

Argasidae tick / *Ornithodoros*

Muscidae fly / *Stomoxys*

Horsefly / *Tabanidae*

Horn fly / *Haematobia*
Elettaria cardamomum & Nerolidol

- “Queen of Spice” (Ravindran 2010)
- South Asia, SEA, Middle East, Africa and Europe.
- In 100gm → 300kcal, 68g CHO, 15g protein, 28g fibers & no cholesterol
- Vitamin A & C, Na, K, Ca, Fe, Mn, P, Cu, Mg & Zn (Cox et al. 2000)

- Nerolidol (C₁₂H₂₆O) → therapeutic effects & significant biological activities (Gao et al. 2008)
Nerolidol: Testimonies

- In-vitro inhibits 95% of *Leishmania amazonensis* and *L. braziliensis* promatigotes growth (Denise at el. 2010)

- Inhibits the synthesis of peptidoglycan molecules in bilayer lipid structure of organism's plasma membrane (Ogunlana et al. 2013)

- Anti-colorectal tumour activity with 68% inhibition rate towards human colon adenocarcinoma cells HCA-2 and HCA-7 (Gayathri et al. 2010)

- Curing asthma and bronchitis symptoms by increasing blood circulation to the lungs (Berhe et al. 2009)

- Oil-based of nerolidol exhibits anti-gonorrhea and anti-nephritis property in male rabbit’s urethra (Turi et al. 2011)
Rationale of the Study

Reliability of Berenil
- Unaffordable $\rightarrow$ expensive in certain regions
- Wrong dosage & concentration $\rightarrow$ side effects

Economic Growth & Biotechnology Sector
- Natural products $\rightarrow$ newest main focus for developing nations
- Widely unutilized lands $\rightarrow$ profitable with cardamom plants
- Cardamom $\rightarrow$ consumable & easily manipulated herbs
- Surra disease $\rightarrow$ influenced productivity of the human & livestock

Current Issues of *T. evansi*
- Trans-host boundary: animal $\rightarrow$ human (Assam India, 2008)
- Strain from India, Egypt & Indonesia are now MDR-strain
- Distribution of vectors $\rightarrow$ potentially could be trans-continents
MATERIALS & METHODS

MATÉRIAUX & MÉTHODES
Experimental Items
**METHODOLOGY**

**Work Flow**

- **T. evansi stock inoculation**
- **T. evansi** i.p. administered (5 × 10^3 T. evansi / mice)
- **0.1 mL 15 µL/mL nerolidol- dH_2O solution:** orally administered

**Giemsam blood smear for inhibition rate evaluation**

**Blood slide for electron microscopic observation**

**Physical observation of symptoms and mice survival**

**Blood biochemistry and renal function tests**

**Vital organ histology for toxicity assessment**
## METHODOLOGY

### Experimental Design

<table>
<thead>
<tr>
<th>GROUP</th>
<th>REGIME</th>
<th>CODE : DESCRIPTION</th>
<th>DOSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREATMENT</td>
<td>PREVENTIVE</td>
<td>PRE14 : 14 days pre-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRE7 : 7 days pre-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRE3 : 3 days pre-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td></td>
<td>CONCURRENT</td>
<td>CON : 30 minutes post-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
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<tr>
<td></td>
<td>CURATIVE</td>
<td>CUR3 : 3 days post-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUR7 : 7 days post-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUR14 : 14 days post-infection</td>
<td>0.1 mL 10 µg/mL nerolidol-dH₂O</td>
</tr>
<tr>
<td>CONTROL</td>
<td>POSITIVE</td>
<td>POS : Berenil (Sigma-Aldrich)</td>
<td>0.01 mL 3.5 mg/kg bw</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
<td>NEG : 0.9 % Normal Saline</td>
<td>0.1 mL 0.9% normal saline</td>
</tr>
<tr>
<td></td>
<td>LETHAL</td>
<td>LWT : Infection without treatment</td>
<td>5 × 10³ T. evansi / mice (I.P.)</td>
</tr>
</tbody>
</table>

Mice : ICR / ♂ / 6 – 8 weeks old / 25 – 30 g bw / n = 6 per group
Nerolidol and normal saline → daily administered (oral) until the mice die.
Berenil → administered intraperitoneally (I.P.) as single dose once the parasitemia density = 20 - 30 %.
Nerolidol (Sigma-Aldrich, Malaysia) → extracted from *Eiettaria cardamomum* (cardamom).
RESULTS & DISCUSSIONS

RéSULTATS & DISCUSSIONS
### Parasite Pre-Patent Period vs Mice Survival Time

<table>
<thead>
<tr>
<th>GROUP</th>
<th>REGIME</th>
<th>GROUP CODE</th>
<th>PARASITE PRE-PATENT PERIOD</th>
<th>MICE SURVIVAL TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREATMENT</td>
<td>PREVENTIVE</td>
<td>PRE14</td>
<td>27.48 ± 1.5</td>
<td>282.58 ± 6.6</td>
</tr>
<tr>
<td></td>
<td>PRE7</td>
<td></td>
<td>18.69 ± 2.2</td>
<td>112.48 ± 2.9</td>
</tr>
<tr>
<td></td>
<td>PRE3</td>
<td></td>
<td>12.44 ± 0.2</td>
<td>55.49 ± 1.0</td>
</tr>
<tr>
<td></td>
<td>CONCURRENT</td>
<td>CON</td>
<td>9.17 ± 3.1</td>
<td>21.60 ± 5.3</td>
</tr>
<tr>
<td></td>
<td>CURATIVE</td>
<td>CUR3</td>
<td>8.53 ± 2.7</td>
<td>18.45 ± 4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUR7</td>
<td>5.98 ± 0.5</td>
<td>16.94 ± 1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUR14</td>
<td>5.05 ± 3.9</td>
<td>15.47 ± 3.7</td>
</tr>
<tr>
<td>CONTROL</td>
<td>POSITIVE</td>
<td>POS</td>
<td>4.73 ± 1.1</td>
<td>&gt; 365</td>
</tr>
<tr>
<td></td>
<td>NEGATIVE</td>
<td>NEG</td>
<td>4.56 ± 0.3</td>
<td>15.01 ± 4.8</td>
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<tr>
<td></td>
<td>LETHAL INFECTION</td>
<td>LTN</td>
<td>5.21 ± 0.7</td>
<td>16.71 ± 2.1</td>
</tr>
</tbody>
</table>

Berenil (POS) was administered intraperitoneally (I.P.) as single dose once the parasitemia density reached 28.17 % on day 9 post-infection.
Parasite Pre-Patent Period

**RESULTS & DISCUSSION**

<table>
<thead>
<tr>
<th>Days</th>
<th>POS</th>
<th>NEG</th>
<th>LTN</th>
<th>PRE14</th>
<th>PRE7</th>
<th>PRE3</th>
<th>CON</th>
<th>CUR3</th>
<th>CUR7</th>
<th>CUR14</th>
</tr>
</thead>
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<tr>
<td>0</td>
<td>4.73</td>
<td>4.56</td>
<td>5.21</td>
<td>27.48</td>
<td>18.69</td>
<td>12.44</td>
<td>9.17</td>
<td>8.53</td>
<td>5.98</td>
<td>5.05</td>
</tr>
</tbody>
</table>

**Infection day (D0)**

- **CONTROL**
- **PREVENTIVE**
- **CONCURRENT**
- **CURATIVE**
RESULTS & DISCUSSION

Mice Survival Time

- **POS**: 15.01 days
- **NEG**: 16.71 days
- **LTN**: 55.49 days
- **PRE14**: 282.58 days
- **PRE7**: 112.48 days
- **PRE3**: 15.01 days
- **CON**: 21.60 days
- **CUR3**: 18.45 days
- **CUR7**: 16.94 days
- **CUR14**: 15.47 days

**DAYS**
RESULTS & DISCUSSION

Parasite Growth & Survival in PRE14 Mice: Day 45

Giemsa thin blood smear of PRE14 mice group taken on day 45 as observed under x100 magnification of light microscope (A) and x5000 magnification of SEM (Phillips XL30, UK) (B)
Giemsa thin blood smear of PRE14 mice group taken on day 90 as observed under x100 magnification of light microscope (A) and x5000 magnification of SEM (Phillips XL30, UK) (B)
RESULTS & DISCUSSION

Parasite Growth & Survival in PRE14 Mice: Day 135

Giemsa thin blood smear of PRE14 mice group taken on day 135 as observed under x100 magnification of light microscope (A) and x5000 magnification of SEM (Phillips XL30, UK) (B)
RESULTS & DISCUSSION

Parasite Growth & Survival in PRE14 Mice: Day 180

Giemsa thin blood smear of PRE14 mice group taken on day 180 as observed under x100 magnification of light microscope (A) and x4000 magnification of SEM (Phillips XL30, UK) (B)
Giemsa thin blood smear of PRE14 mice group taken on day 225 as observed under x100 magnification of light microscope (A) and x5200 magnification of SEM (Leo 1450VP, Japan) (B)
RESULTS & DISCUSSION

Parasite Growth & Survival in PRE14 Mice : Day 275

Giemsa thin blood smear of PRE14 mice group taken on day 275 as observed under x100 magnification of light microscope (A) and x4600 magnification of SEM (Leo 1450VP, Japan) (B)
Reemerged of *T. evansi* which survived in PRE14 mice group on day 280 (A) and day 281 (B) due to the action of ‘variable surface glycoprotein (VSA) stochastic genetic modification’ as observed under x100 magnification of light microscope.
Reemerged of *T. evansi* which survived in PRE14 mice group on day 280 (A) and day 281 (B) due to the action of ‘variable surface glycoprotein (VSA) stochastic genetic modification’ as respectively observed under x1600 (A) and x2300 (B) magnification by SEM (Leo 1450VP, Japan).
The growth of *T. evansi* in POS mice group taken on 1 hour (left) and 2 hours (right) post-treatment (0.01 mL 3.5 mg/kg bw Berenil) as observed under x100 magnification of light microscope (A1 & B1) and x5000 magnification of SEM electron microscope (Phillips XL30, UK) (A2 & B2)
The growth of *T. evansi* in POS mice group taken on 3 hours (left) and 4 hours (right) post-treatment (0.01 mL 3.5 mg/kg bw Berenil) as observed under x100 magnification of light microscope (A1 & B1) and respectively under x3000 (A2) and x2000 (B2) magnification of SEM electron microscope (Phillips XL30, UK)
Parasite Growth & Survival in POS Mice: 5th & 6th hour

The growth of *T. evansi* in POS mice group taken on 5 hours (left) and 6 hours (right) post-treatment (0.01 mL 3.5 mg/kg bw Berenil) as observed under x100 magnification of light microscope (A1 & B1) and x5000 magnification of SEM electron microscope (Phillips XL30, UK) (A2 & B2)
SEM micrograph showed the morphological changes of *T. evansi* in PRE14 mice on 275\textsuperscript{th} day post infection (x5000, Leo 1450VP, Japan), 7 days just before the mice die (A) and in POS mice at 6\textsuperscript{th} hours post infection (x5000, Phillips XL30, UK) (B)
**RESULTS & DISCUSSION**

### Biochemical Tests For In-Vivo Toxicity Assessment

<table>
<thead>
<tr>
<th></th>
<th>TA (±)</th>
<th>TB (±)</th>
<th>TC (±)</th>
<th>TD (±)</th>
<th>CN (±)</th>
<th>CI (±)</th>
<th>NR</th>
<th>Unit</th>
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</thead>
</table>
| **ALT** | 41.81 ± 2.14 &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&n...
Organ Histology For Toxicity Assessment

KIDNEY

LIVER

Treatment (Acute)  Treatment (Sub-acute)  Control
Stochastic genetic modification of VSG is still the best weapon for trypanosome survival (Nok et al. 1996).

New wave of infection → mice is susceptible to infection (Ogunlana et al. 1944)

Generally, nerolidol able to prolong the survival rate of the mice although the parasitemia density is quite high.

Significantly, curative regime are less effective than other treatment regimens.

Longer prophylactic duration → longer survival rate of the patient although the parasitemia has reached almost 50%.

Alteration of dosage, concentration and period of prophylactic treatment → significant antiparasitic activity of nerolidol.
Suggestions & Future Directions

1. Mechanisms of actions & molecular approaches
2. Extract of *E. cardamomum* daily doable for consumer
3. Play around with different concentration & dosage
4. To deal with stochastic genetic modification of VSG
5. Screening against *T. cruzi*, *T. brucei*, *Leishmania* spp. etc..
6. Holistic OH approach towards multidisciplinary collaboration → veterinary & medical doc, parasitologist, entomologist, botanist, zoologist, geologist, chemist, educationist, policy makers & politicians, local & global public, etc..


ACKNOWLEDGEMENT

RECONNAISSANCE
ACKNOWLEDGEMENT

Approval For One Health Scholarship

SEAOHUN OH Travel Grant

Approval For Travelling Abroad

Approval For Attending The Conference

One Health Networking / Exposure

Research Facilities / Instrumentation
‘Variable Surface Glycoprotein’ (VSG)

- Survival factor of *Trypanosoma* spp. in the infected host
- High density layer on the parasite cell membrane
- Contained $1 \times 10^9$ similar & uniformed glycoprotein molecules expressed by VSG-*Trypanosoma* gene
- Protect the parasite from being identified/action of the host immune system
- Similar & uniformed glycoprotein molecule $\rightarrow$ only end region of `N-terminal loops’ structure (300-500 amino acid structures) can be identified by the host immune systems $\rightarrow$ specific antibody-antigen mechanisms
‘Variable Surface Glikoprotein’ (VSG) – cont.

- When the end region of `N-terminal loops’ structure being identified by the host immune systems $\Rightarrow$ VSG-stochastic genetic modification’ of the parasite plays the role.

- VSG stochastic genetic modification = periodic changes of antigenic variation $\Rightarrow$ the structures & characteristics of parasite cell membrane was modified whenever confronted with the host’s specific immune system which may varies.

- Periodic changes of antigenic variation $\Rightarrow$ changes in parasitemia waves $\Rightarrow$ longer survival time of the parasite $\Rightarrow$ chronic infection on host
Survival Pattern of the Trypanosomiasis Infected-Host Due to VSG-Stochastic Genetic Modification Phenomenon

Effectuation of the changes in host’s specific immune system

Mechanism of Trypanosome VSG-stochastic genetic modification

Day of Infection

Latent Period

(*): Day of Infection

(*): Latent Period