LC_{50} of ginger rhizome on Continuous Utilization in *Drosophila melanogaster*

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Abstract
This study evaluated the toxicity (LC_{50}) and survival effects of *Zingiber officinale* (ginger) rhizome extract on *Drosophila melanogaster*. Fresh rhizomes were collected, air-dried at room temperature, powdered, and extracted using 70% ethanol by maceration. The dried extract was weighed to estimate total yield. Harwich strain *D. melanogaster* (3–5 days old) were obtained from the Africa Centre of Excellence in Phytomedicine Research and Development (ACEPRD), University of Jos, Nigeria, and maintained under standard conditions (23 ± 1 °C; 60% RH; 12 h light/dark cycle) on a cornmeal-based diet. A pilot assay was first conducted to establish safe test concentrations. Acute toxicity was then assessed over seven days to determine the LC_{50}, followed by a 28-day survival assay at sub-lethal concentrations. Results showed that exposure to 20–1000 mg/10 g diet caused dose-dependent mortality, with 100% mortality observed at 1000 mg/10 g diet. The 168-hour LC_{50} was determined to be 359.8 mg/10 g diet, suggesting that ginger rhizome extract is relatively non-toxic. Long-term exposure at sub-lethal doses significantly ($p < 0.05$) extended the lifespan of *D. melanogaster* compared to controls. These findings indicate that *Z. officinale* rhizome possesses protective and longevity-enhancing effects, likely mediated by its antioxidant and metabolic regulatory properties.

Keywords: *Zingiber officinale*, LC_{50}, *Drosophila melanogaster*, survival assay, antioxidant, toxicity.

DESCRIPTION OF PROBLEM

Meat tenderness is a major determinant of consumer preference, alongside flavor and juiciness [1&2]. It is considered the most important eating quality trait and strongly influences purchasing decisions and repeat buying [3]. Toughness in aged animals is linked to collagen cross-linking and connective tissue changes [4]. To improve tenderness, natural proteolytic enzymes from plants such as ginger, pawpaw, and turmeric are increasingly applied [5]. *Zingiber officinale* (ginger) is a perennial rhizome of the Zingiberaceae family, cultivated widely in tropical regions including Nigeria and India [6]. It contains proteases (GP-I and GP-II) similar to papain [7] and bioactives like gingerols and shogaols responsible for its pungency and medicinal value [8]. Ginger protease is highly active on collagen, making it an effective natural tenderizer. *Drosophila melanogaster* is a widely used model organism, sharing 60% of its genome and 75% of human disease-related genes [9]. Its short life cycle and low maintenance make it suitable for toxicological and antioxidant studies. Although ginger is widely consumed, high doses may cause gastric irritation, reflux, or allergic reactions [10]. Hence, its long-term safety requires further study. This research investigates the LC50 of ginger rhizome on Continuous Utilization in *Drosophila melanogaster*.

MATERIALS AND METHODS

Plant material: *Z. officinale* rhizome

Experimental Animal: *D. melanogaster* (3-5 days old) were used. Animals were breed in Fly Lab Africa Centre of Excellence in Phytomedicine Research and Development University of Jos, Jos Nigeria (ACEPRD). Species Stock are maintained at constant temperature and humidity (23±1 °C; 60% relative humidity, respectively) under

12 hour dark/light cycle. The animals were maintained on a fly diet. The diet is composed of Yellow maize flour (Carbohydrate), Yeast (protein), Agar-Agar (stabilizer), Methyl Paraben (preservatives), water (solvent). These flies are house in clean culture bottles with an air pore cork. All treatment was done using clean treatment vials.

Hydroethanolic Method of Extraction: Collected rhizome of *Z. officinale* was weighed and allowed to dry in normal room temperature (to avoid denaturation of active elements). The dry weight was scored and used for Moisture content estimation. The dried rhizome was reduced to fine powder by grinding and sieving. The weight of the fine powdered rhizome was scored and taken for maceration in 70 % ethanol for 72hrs. The Mixture was filtered and the filtrate was concentrated to dryness. The dried extract was weighed and used for total yield estimation.

Pilot assay: Pilot assay was conducted to determine suitable concentration of *Z. officinale* hydroethanolic rhizome extract that would not result in outright mortality of *D. melanogaster* within specified period of time. The acute test was carried out to determine the LC50 of plant extract which take seven days. The LC_{50} obtained were used for the survival assay and treatment.

Results and discussions

168 Hours LC_{50} and 28 Days Survival Assay

After seven days exposure of *D. melanogaster* to 20 mg, 40 mg, 80 mg, 125 mg, 250 mg, 500 mg and 1000 mg per 10 g diet, there was 100 % mortality in the highest concentration. The 168 hours LC_{50} was determined to be 359.8 mg/10 g diet as shown in Figure 1. Concentrations (25 mg, 50 mg, 100mg and 125mg per 10 g diet) are below LC_{50}= 359.8 mg/10 g.

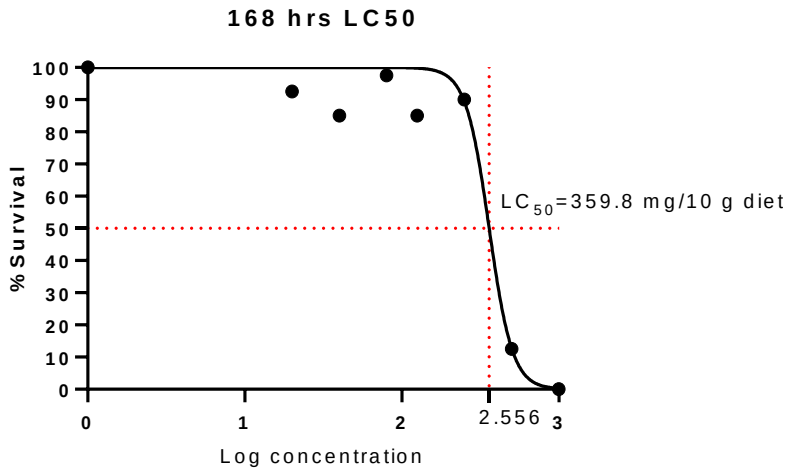

Figure 1: 168 hours LC_{50} of Ginger ethanol rhizome extract in *D. melanogaster* (168 hrs. LC50= 359.8 mg/10 g diet)

Discussion

168 Hours LC_{50} and 28 Days Survival Assay

Plant extract can be beneficial or detrimental to a living organism either by ingestion, inhalation or contact; the detriments of ingesting toxic plants are many ranging from malfunctioning of the system, immune-suppression and short life span while benefits of some plant extracts ranged from being protective,

medicinal (preventive and curative activity) to longevity activity [11]. A plant extract with low LC_{50} is known to be very toxic while that with high LC_{50} is known to be less or non-toxic. From our 168 hour LC_{50} of ginger rhizome ethanolic extract was determined to 359.3 mg/10 g diet, which is a concentration that can kill 50% of test organisms. This high LC_{50} might suggest less or non-toxic activity of this extract. To further establish the safety of this extract, flies were exposed to concentrations far below the LC_{50} for 28 days and our result revealed the significant positive effect ($p<0.05$) on life expectancy. The extract significantly extend ($P<0.05$) the life span of flies with increase in concentration compared to the control group, agreeing with many authors, who have documented the safety of ginger rhizome. Similarly, Zhou [12], reported that ginger extract extends the lifespan of *D. melanogaster* through antioxidation and ameliorating metabolic dysfunction.

Conclusion and Application

From the experimental results it can be concluded that ginger is not toxic to *D. melanogaster*. Ginger ethanolic extract has protective activities.

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