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Research Article

Toxicity Assessment of Costus Igneus Leaf Extract on Germination and Early Growth of Hordeum Vulgare L.

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ABSTRACT

The experiment explored the potential toxicity of Costus igneus leaf extract on the early development of barley (Hordeum vulgare L.). Costus igneus, also known as the insulin plant, is widely used for its supposed antidiabetic properties, but there is limited scientific data concerning its impact on living organisms. In this study, barley seeds were subjected to different concentrations (0.1%, 0.2%, and 0.3%) of the plant's aqueous leaf extract, while untreated seeds were used as a control. The researchers measured various factors including germination rate, root and shoot growth, total seedling height, vigor index, and survival percentage. The results showed that none of the tested concentrations adversely affected seed germination or seedling survival compared to the control. Interestingly, a slight increase in seedling height was noted at the highest concentration tested (0.3%), implying that the extract might promote early growth. Statistical evaluation revealed no meaningful differences from the control. Therefore, within the tested concentrations, Costus igneus leaf extract appears to be non-toxic to barley seedlings and may even encourage better early-stage growth. Additional research, including cytological and in vivo assessments, is suggested to further clarify its safety profile.

INTRODUCTION

The medicinal use of plants is probably as old as human kind itself. Many folk remedies and herbal medicines employ plants with therapeutic and health-improving characteristics. In recent times, purely scientific study on the effect of such herbal preparations on different health parameters has been flourished worldwide (More *et al.*,2021). Diabetes mellitus is a chronic disease which causes millions of deaths worldwide each year as a result of the associated complications (International Diabetes Federation,2013). Diabetes is becoming the third "killer" of the health of mankind along with cancer, cardiovascular and cerebrovascular disease

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(Donga *et al.*,2011). Type II diabetes is the more predominant form of the disease, in which the body does not produce sufficient amounts of insulin, or in some cases, the body is resistant to insulin. *Costus igneus* is native to South and Central America. This is a recent introduction to India from America as an herbal cure for diabetes and hence commonly called as 'insulin plant' (Jose and Reddy,2010). It is widely grown in gardens as ornamental plant in South India and also run wild in many places (Benny, 2004). It is used in India to control diabetes, and it is known that diabetic people eat one leaf daily to keep their blood glucose low (Urooj, 2008). In most countries there is no universal regulatory system ensuring the safety and activity of natural products and they had not been sufficiently investigated analytically or toxicologically (Valerio and Gonzales, 2005). Herbal medicines can be potentially toxic to human health. In this way, scientific research has shown that many plants used in traditional and folk medicine are potentially toxic, mutagenic, and carcinogenic (Mengs, 1988; Ferreira-Machado *et al.,* 2004). 'Toxicity' is a more general term for how harmful a substance is to an organism There are many compounds that are harmful. Scientists and medical practitioners must be aware of the impacts and the degree to which each substance might harm an organism because some are more hazardous than others. Toxicology is dose-dependent. Toxic substances are to be eliminated as early in the drug development process as possible through toxicology studies. Researchers can simultaneously detect numerous toxicity biomarkers for different organs using multiplex toxicity assays to better understand drug-induced harm. Barley can be used to assess the toxicity of particular chemical substances. In present attempt Barley (*Hordeum vulgare* L.) is used as a model plant to evaluate the toxicity of specific chemical compounds on living organism.

Morphology of *Hordeum vulgare* L.*:*

There are four distinct parts of a plant: the root, tiller, leaves, and spike. The fundamental or seminal roots and the adventitious roots are two sets of simple axial structures that lack any leaf like organs, nodes, or internodes. At maturity, the tiller has a cylindrical shape made up of solid nodes or joints with transverse septa separating the hollow internodes. The internode diameter decreases towards the top of the plant, and the basal internode is the shortest. The tiller's last node to the collar, also known as the peduncle, is when the tiller changes into the rachis of the spike. The four components of a barley leaf are the sheath, ligule, auricles, and blade. Leaves will vary in size, shape, and colour. The indeterminate spike, also known as the inflorescence or flower head of barley, is an axis (rachis) that does not end in a spikelet. A solid, flat, zigzag rachis with different numbers of spikelets attached at the nodes makes up the barley spike, which is found near the apex of the stem neck. The ovule and anthers are both present in barley flowers, which are primarily self-pollinating. Two flowering glumes, the lemma and palea, which develop into the hulls in the mature kernel, surround the ovary and stamens in each floret. Caryopsis is the fruit that develops following fertilization. The pericarp, test a (seed coat), epidermis nucellus, endosperm, and embryo make up the caryopsis. The ripe barley grain has an oval shape and is more elongated than (Newman and Newman, 2008). Most often *Costus species* are consumed raw for their different health benefits by the people worldwide. Even though they are effective against diabetes and various diseases, certain side effects might occur due to their consumption. There must be evaluation of adequate dose of these medicinal plants to prevent their negative effect on life systems and thus present investigation aimed at evaluation of

toxicity of *Costus igneus* on germination and growth parameters of *Hordeum vulgare* L. seeds.



Costus igneus



Seeds of *Hordeum vulgare*

MATERIAL AND MATHODS: - For evaluation of toxicity of *Costus igneus* against Barley (*Hordeum vulgare L.)* seeds, following procedure is carried out –

1. Collection of plant material

The *Costus igneus* plant was collected from Achalpur, Dist. Amravati, Maharashtra.

Botanical name: *Costus igneus*

Kingdom: Plantae

Class: Liliopsida

Subclass: Commelinidae

Superorder: Zingiberanae

Order: Zingiberales

Family: Costaceae

Genus: *Costus*

Species: *igneus*

It is a perennial, upright, spreading plant fall over and lie on the ground, and it grows to a height of about two feet. Leaves are simple, alternate, entire, oblong, evergreen, 4-8 inches in length and have parallel venation. The large, smooth, dark green leaves of this tropical evergreen have light purple undersides and are spirally wrapped around stems to create elegant, arching bunches. Beautiful, 1.5-inch diameter, orange flowers are produced in the warm months, appearing on cone-like heads at the tips of branches. Fruits are inconspicuous, not showy, less than 0.5 inch, and green-colored(Gilman, 2012).

2. Selection of Material

The certified barley (*Hordeum vulgare L.)* seeds were taken. Total 600 seeds were used in four treatments (150 Seeds each), three replications for every treatment.

3. Preparation of extract

Fresh plant leaves were thoroughly washed with running distilled water, weigh and crushed in mortal and pastel to prepare stock solution (2gm leaf in 200ml DW).

4. Treatment to Barley seeds

Doses of 0% (control),0.1%, 0.2% and 0.3% concentration were prepared by using *Costus igneus* plant extract solution. Physiologically similar seeds were directly soaked in solution of CE and kept in Remi Orbital Shaking incubator at 100rpm for 18 Hrs. For each treatment about 200ml solution is used. After chemical treatments seeds were rinsed trice with running water to completely remove extract and post soaked for 30 min in distilled water.

5. Seed Germination percent:

For germination study, 25 seeds of each dose along with control were kept in on moist blotting paper in triplicates. Actively emerging radicals were considered as criteria for germination. Seed germination data was recorded after 3 days. Seed germination percentage, percentage over control and reduction over control was calculated.

6. Seedling Growth parameter:

Procedure given by More and Malode (2018) was adopted for seedling height measurement. 15 seeds were arranged in slots of blotting paper kept in trays for seedling height determination. Data of seedling height i.e., shoot length, root length and seedling survival was recorded after 7 days. Seedling vigour index was calculated by following formula -

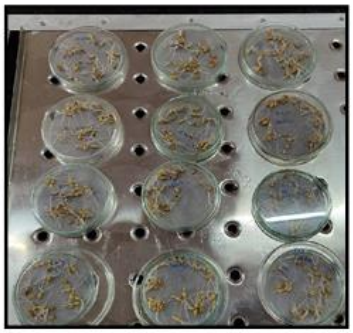
Seedling Vigour Index = Seed Germination percent × Seedling Height



***Costus igneus* extract treatment to seeds**



Seeds kept for germination on blotting paper



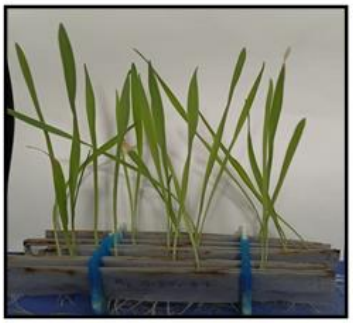
Seed Germination



Seed arranged in blotting paper slot



Germination counts after 3 days



Seedling height count after 7 days

RESULT AND DISCUSSION: - Effects of *Costus igneus* on various parameters like seed germination, seedling growth were evaluated (Table 1 and Table 2).

Seed Germination Percentage

A seed is a genetic package. After a time of dormancy, it begins to grow when water is ingested. This leads to the enlargement of the embryo, the production of cell walls, the activation of metabolic signaling, and the radical protrusion of the seed. The entire process is referred to as germination. This procedure is the first phase of any seed propagation strategy. (Barroco*et al.,* 2005).

Table 1: Effect of different concentrations of *Costus igneus* leaf extract on Seed germination of *Hordeum vulgare L.*

Sr. No.	Concentrations	Germination Parameters		
		%G	%GOC	%ROC
1	Control	94.7%	100%	0%
2	0.1% CLE	94.7%	100%	0%
3	0.2% CLE	90.6%	95.8%	-4.2%
4	0.3% CLE	97.4%	102%	2%
CLE- *Costus igneus* Leaf Extract, %G- percent gemination, %GOC- percent gemination over control, %ROC- percent reduction over control				

Table 1 contains information on the effects of various concentrations of the 18-hour *Costus igneus* treatment on seed germination percentage in *Hordeum vulgare* L. All treatments *of Costus igneus* leaf extracts shows significant germination rate of barley followed by control. While 0.3% CLE demonstrated a rise in germination percentage over the control, which is sometimes referred to as a stimulating effect, 0.2% CLE showed the lowest germination rate. These might be the result of an active repair system, which immediately repairs any errors that are made in the metabolic pathways necessary for typical seed germination.

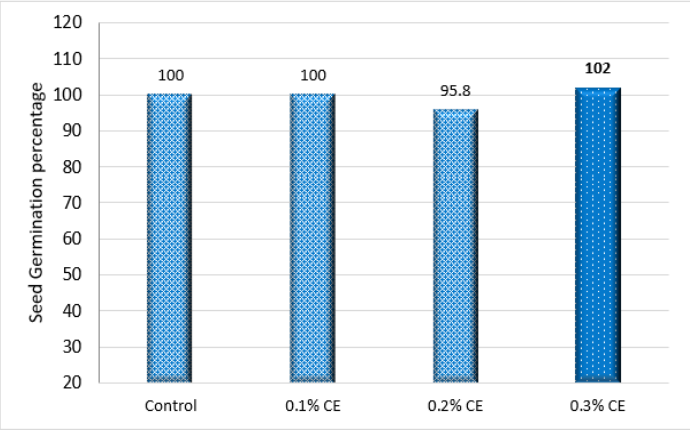


Figure 1: Effects of Different Concentration of *Costus igneus* Leaf Extract on Seed Germination of *Hordeum vulgare L.*

The percent germination in seed depends on the nature of the concentration of treatment doses. Most of the time it is found that raw plant leaf consumption shows clastogenic (chromosome damaging) effects on cytology of human as well as plant cells.

Seedling Height and Seedling Survival

Data on effects of different concentration of 18Hrs. *Costus igneus* leaf extract treatment on seedling height in *Hordeum vulgare* L. are tabulated in Table 2, Figure 2. All treatments show Seedling height increased over the control (25.57cm) except 0.2% concentration. Maximum seedling in height observed in 0.1% concentration of *Costus igneus* leaf extract treatment (32.62cm) followed by 0.3% concentration with seedling height 32.09cm.

Most treatments had not impacted the seedling development and survival after the initial phase of treatment. All the treatments showed increased seedling height compared to control(25.57cm). 0.3% CLE showed the maximum growth with 33.8cm seedling height. Whereas 0.1% CE and 0.2% CLE showed 32.62cm and 32.04cm seedling height respectively. This may be explained by the fact that *Costus igneus* leaf extract enhanced the rate of cell division while not altering normal cell division, which may have been brought on by a rise in the production of regulatory proteins necessary for cell division.

Table 2: Effect of different concentrations of *Costus igneus* leaf extract on Seedling Height of *Hordeum vulgare* L.

Sr. No.	Concentrations	Seedling Parameters			t-value	SVI	SS%
		S.L.	R.L.	SH			
1	Control	13.89±0.71	15.45±0.90	25.57	-	2557	75.6%
2	0.1% CLE	16.25±0.69	16.37±0.85	32.62	0.337	3262	86.7%
3	0.2% CLE	14.65±0.82	17.39±0.99	32.04	0.987	2125	60%
4	0.3% CLE	16.13±1.21	17.69±1.21	**33.8**	0.648	3356	82.3%
CLE- *Costus igneus* Leaf Extract, SL- Shoot length, RL- Root length, SH- Seedling height, t-value- Tabulated t-value- $t_{0.05}$ at df=14 is 1.761 SVI-Seedling Vigor index, %SS- Percentage Seedling Survival							

As the calculated t-values are less than tabulated t value, null hypothesis is accepted. Hence variations in seedling height after treatment were not significant.

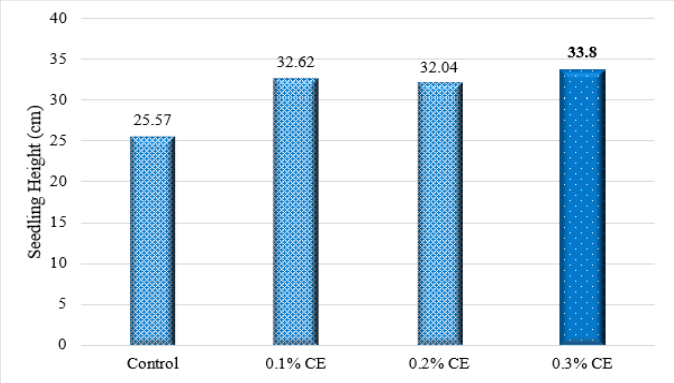


Figure 1: Effects of Different Concentration of *Costus igneus* Leaf Extract on Seedling Height of *Hordeum vulgare L.*

Increase or decrease in seedling height over the control might be due to stimulatory or inhibitory effect of *Costus igneus* leaf extract on the physiological system respectively.

SUMMARY AND CONCLUSION: -

People all across the world most frequently take them raw for their various health benefits. Although they are effective in treating a variety of diseases, they have some side effects that limit their use as traditional medicines. To avoid these therapeutic herbs' detrimental effects on the systems that support life, the appropriate dosage must be evaluated.

Seedling growth and cytological study is an effective tool to evaluate cytotoxic and genotoxic effects of certain chemical extracts. These methods can be effectively employed to check hazardous effects of certain plant extracts, insecticides, pesticides, herbicides, other chemical compounds and even heavy drugs used to treat certain devasting diseases.

Present investigation aimed at evaluating cytotoxic and genotoxic effect of *Costus igneus* on growth parameters of barley (*Hordeum vulgare*). *Costus igneus* leaf extract does not found to affect seed germination or seedling survival and hence not found to have any lethal effect on seedlings of barley. All the treatments along with control shows Significant germination and seedling survival. All the concentrations *Costus igneus* showed increase in seedling height over the control may be attributed to stimulatory effect on regulatory proteins. Maximum seedling height was found to be shown by 0.3% concentration (33.8cm); while control shows minimum value for seedling height (25.57cm).

Further research was needed to check comparative Cytotoxicity and Genotoxicity of *Costus igneus* on animal and human cells.

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