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Comparative anatomical and biochemical studies of *in vitro* and *in vivo* plants of ginger

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INTRODUCTION & AIM

- ✓ ***In vitro*** **propagation offers disease free-material in ginger (*Zingiber officinale* Rosc.), a plant of significant medicinal and commercial value.**
- ✓ **Tissue culture-derived plants are generally anticipated to have a more benefits over *in vivo* propagated plants, including reduced disease infection rates, enhanced crop quality, stronger growth vigor, and increased economic output (Wojcik et al., 2020)**
- ✓ **This study aims to dwell into anatomical and biochemical characters of *in vitro* and *in vivo* plants of ginger**

METHOD

Fifty day old *in vitro* (developed from tissue culture lab maintained at 25 ± 2°C, 90-92% RH, 14 h photoperiod at 3000 lx) and *in vivo* plants (pro tray plants grown in poly house maintained at 25 ± 2°C and 60-70% RH) of ginger variety IISR Varada was taken for anatomical studies and visualized under light microscopy by staining with safranin.

Fifty-day-old *in vitro* and and *in vivo* plants of the ginger varieties IISR Varada, IISR Rejatha and Karthika were taken for biochemical analysis including pigments viz., chlorophyll (Devlin, 1971) and carotenoids (Yang et al. (1998), enzymes like peroxidase (Pütter, 1974), catalase (Aebi, 1984), Super Oxide Dismutase (Madamanchi et al.,1994), reducing sugars (Nelson-Somogyi method), starch (Hedge and Hofreiter,1962).

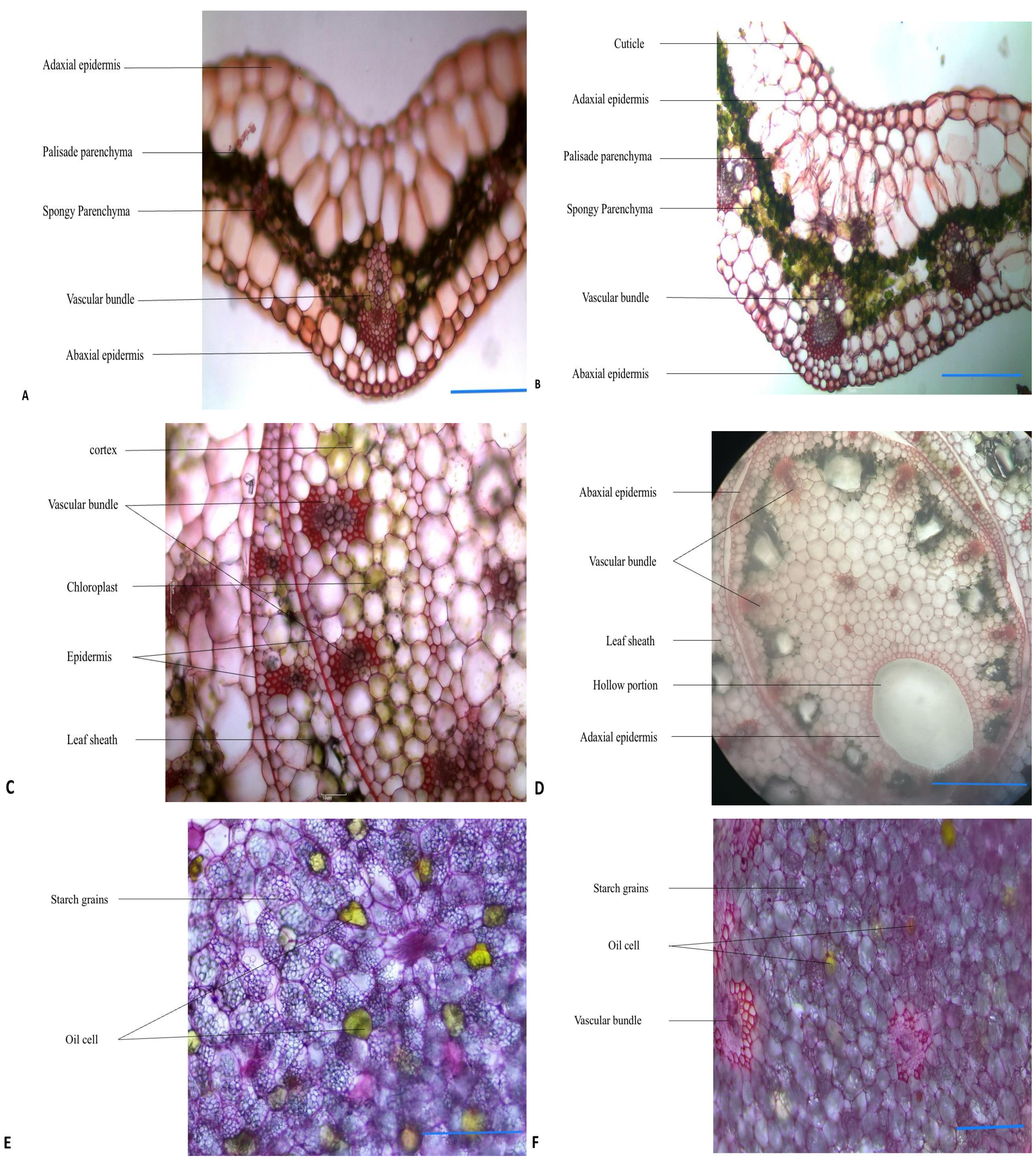

Fig.1. (A) Leaf anatomy of *in vitro* ginger-4X (B) Leaf anatomy of *in vivo* ginger-4X (C) Pseudostem anatomy of *in vitro* ginger plant-10X (D) Pseuodstem anatomy of *in vivo* ginger plant-10X (E) Transverse section of *in vitro* ginger rhizome-10X (F)Transverse section of *in vivo* ginger rhizome-10X

RESULTS & DISCUSSION

- **Anatomically both *in vitro* and *in vivo* plants exhibit similarities in leaf structure- uniseriate epidermis and dorsiventral mesophyll arrangement, while differing in the thickness of spongy parenchyma, presence of stomata, oil cells, air canals and vascular bundle distribution.**
- ***In vitro* propagated pseudo stems exhibit closely bound leaf sheath and pseudo stem epidermis, unlike their *in vivo* counterparts. Rhizome analysis revealed larger vascular bundles in *in vivo* ginger and higher starch and sugar content in *in vitro* rhizomes.**
- **This difference in anatomical characters is due to the environment in which these plants are grown**
- **Biochemical analysis revealed higher chlorophyll and carotenoid content in *in vivo* plants in contrast to *in vitro* plants, mainly due to incomplete chloroplast development and reduced pigment synthesis**

Table1: Biochemical parameters of in vitro and in vivo plants of different ginger varieties

Biochemical parameters	IISR Varada		IISR Rejatha		Karthika	
	In vitro	*In vivo*	*In vitro*	*In vivo*	*In vitro*	*In vivo*
Chlorophyll a (mg/g)	0.5114	0.8716	0.8766	1.0657	0.8872	1.1332
Chlorophyll b (mg/g)	0.2058	0.3273	0.4222	0.5177	0.3696	0.5311
Total chlorophyll (mg/g)	0.7173	1.1989	1.2988	1.5834	1.2568	1.6643
Carotenoid (mg/g)	50.876	67.240	78.282	81.942	75.335	101.723
Soluble sugars (%)	0.0931	0.0492	0.1669	0.0867	0.6303	0.0405
Starch (%)	22.8441	16.8075	24.9783	18.1422	17.6544	17.2682

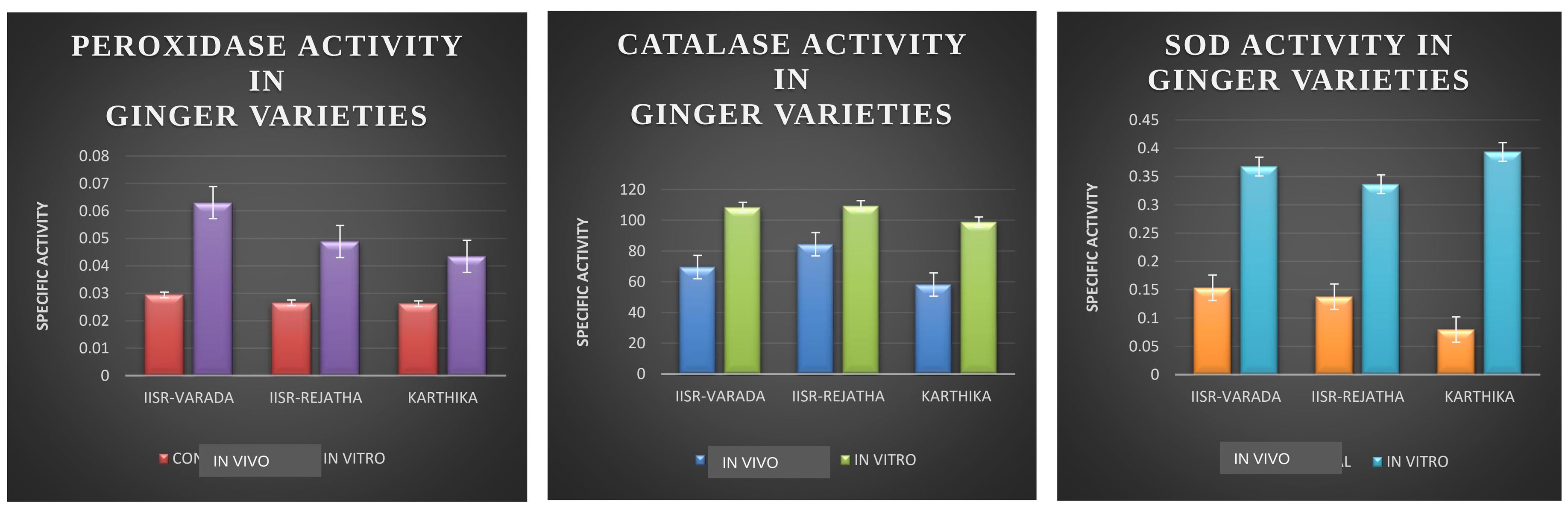

Fig 2: Antioxidant enzyme activities of *in vitro* and *in vivo* plants of different ginger varieties

CONCLUSION

•A clear cut variation is observed between anatomical and biochemical parameters of *in vitro* and *in vivo* plants of ginger
•*In vitro* plants, grown in controlled conditions with limited light, -tend to store starch due to reduced growth and energy needs.
-exhibit higher antioxidant enzyme activity due to increased reactive oxygen species (ROS) production, prompting a stronger antioxidant response.
•Also, *in vitro* plants rely more on biochemical defences to cope with stress from synthetic media and confined growth, *unlike in vivo* plants, which benefit from natural protective mechanisms and external environmental adaptations.

FUTURE WORK / REFERENCES

The study paves the way for enhancing stress resilience, and optimizing nutritional and medicinal properties, thereby contributing to sustainable ginger cultivation

References

Beauchamp, C., & Fridovich, I. (1971). Superoxide dismutase: improved assays and an assay applicable to acrylamide gels. *Analytical biochemistry*, *44*(1), 276-287.
Devlin F. H. W. D. F. B. R. M. (1971). *Experiments in plant physiology*. CiNii Books.
Hedge, J.E. and Hofreiter, B.T. (1962). In: Carbohydrate Chemistry, 17 (Eds. Whistler R.L. and Be Miller, J.N.), Academic Press, New York.