Biological Forum – An International Journal **14(3): 741-745(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

In-vitro Evaluation of Ginger (*Zingiber officinale* Rosc.) Rhizome Extract with the Recommended Chemical under different against Fungal Pathogens

Manvendra Choudhary* and Rajni Singh Sasode
Department of Plant Pathology,
Rajmata Vijyaraje Scindia Krishi Vishwa Vidyalaya Gwalior (Madhya Pradesh), India.

(Corresponding author: Manvendra Choudhary)*
(Received 01 June 2022, Accepted 25 July, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Ginger (*Zingiber officinale* Rosc.) the gingerols are the main pungent compounds found in ginger. Ginger's nutritional profile includes protein, lipids, carbohydrates, minerals, vitamins, and trace nutrients. The purpose of this study is to evaluate the antifungal activity of crude, powdered, boiled, and ethanol extracts of ginger against test pathogens. In-vitro testing of ginger rhizome extract with the recommended chemical against fungal *pathogens Sclerotium rolfsii, Colletotrichum gloeosporioides, Sclerotinia Sclerotium, Fusarium pallidoroseum, Alternaria solani, Fusarium oxysporum* f. sp. *Ciceri, Alternaria alternate*. The overall effectiveness of powdered and boiled extract against the corresponding fungus was progressively increased with increasing concentration from 20% to 50%, but complete suppression of the different test fungus could not be accomplished even at the maximum concentration, 50%. Carbendazim (0.1%) and mancozeb (0.2%) were found to be more effective than *Zingiber officinale* rhizome extract (powdered/boiled) up to a concentration of 50%. Extracts are more effective at higher concentrations.

Keywords: Ginger, *In-vitro*, Fungal pathogens, Powdered extracts and Boiled extracts.

INTRODUCTION

The rhizomes of ginger (*Zingiber officinale* Rosc.) contain both aromatic and pungent compounds (McGee, 2004). Gingerol 6-gingerol [5-hydroxy-1-(4'-hydroxy-3'-methoxyphenyl)-3-decanone] a yellow pungent body; an oleoresin-"gingerin" the active principle, Protein, lipids, carbohydrates, minerals, vitamins, and trace nutrients are all found in ginger. Capsaicin, curcumin, limonene, and proteolytic enzymes are also found in ginger. It is also one of the most effective carrier herbs, with the ability to boost digestive absorption by up to 200 percent (Belewu, 2006). Many countries experienced yield losses due to vegetable diseases caused by soil-borne plant pathogens. Damping-off, root rot, and wilt of vegetables are considered the most damaging diseases (*Fusarium solani, Fusarium oxysporum, Sclerotium rolfsii, Rhizoctonia solani, Alternaria solani, Macrophomina phaseolina*, and *Pythium* spp) (Abdel-Rehim *et al*., 1987; Celar, 2000). Gingerols are the main pungent compounds found in ginger. Ginger's nutritional profile includes protein, lipids, carbohydrates, minerals, vitamins, and trace nutrients. Ginger also contains capsaicin, curcumin, limonene, and proteolytic enzymes. It is also one of the best carrier herbs, with the potential to increase digestive absorption by up to 200 percent (Belewu, 2006). Furthermore, their use in agriculture could be a viable alternative for inclusion in disease control systems, acting as either primary or adjuvant antimicrobial compounds. Zingiberon, bisabolen, camphene, geranial, linalool, and borneol are antimicrobial components of gigeroil. Phytochemicals found in medicinal plants have antimicrobial properties against some plant pathogenic fungi. However little research has been undertaken on the antifungal activity of these extracts. The purpose of this study is to evaluate the antifungal activity of crude, powdered, boiled, and ethanol extracts of ginger against test pathogens.

MATERIAL AND METHOD

The different forms were evaluated *in vitro* against different pathogen under CRD replicated thrice.

Experiment Details-
Design - CRD
Replication- 3
Treatment- 4

Details of treatment
(A) **Pathogens-** *Rhizoctonia solani, R. bataticola, Colletrotrichum gloeospoioides, Fusarium pallidoroseum, F. oxysporum* f. sp. *cicer, Phoma*

sorghina, Sclerotium rolfsii, Sclarotinia sclerotium, Alternaria solani, A. alternate.

Extract

1. Powdered extract: To prepare powder extract, fresh rhizomes of *Zingiber officinale* will be thoroughly washed in ordinary tap water, cut into small pieces, and dried in an oven at 60% for two days.

2. Rhizome crude extract: The rhizome of *Zingiber officinale* will be ground to make the crude extract. Before grinding, an equal amount of water (1:1 weight/volume basis) will be added. For in-vitro testing, crushed extracts will be used at a concentration of 20%.

3. Boiled extract: The fresh Rhizome of *Zingiber officinale* will be washed, dried in the shade, weighted, and boiled for two hours before being filtered and water added to maintain a 1:1 weight/volume ratio. The extract will be stored and used for bioassay of the test fungus at a concentration of 20%.

4. Ethanol Extracts: Twenty grammes of this powder were soaked in 200 ml of the solvent ethanol for 24 hours to make an ethanol extract. The filtrate was then evaporated to dryness after being filtered through Whattman filter paper no. 1. This powdered dried extract was then dissolved in distilled water.

RESULT AND DISCUSSION

It is clear that *Z. officinale* rhizome extract in powdered form at 40% and 50% concentrations significantly inhibited the growth of *R. solani*, but not completely; however, absolute inhibition was recorded in carbendazim (0.1%) treatment. Both chemicals outperformed the *Zingiber officinale* rhizome extract at both concentrations (40 and 50 percent). Higher concentrations of *Zingiber officinale* rhizome extract (50%) outperformed lower concentrations (40 percent). In the 50% and 40% concentrations, an average of 7.5 and 17.5 mm growth was recorded, respectively, with a maximum of 89.2 mm growth recorded in the control (Shamim *et al.*, 2004). Presently, worked on the control of seedlings damping-off diseases is mainly based on the application of fungicides and the adverse effects of these fungicides on environment and human health have focused the efforts on developing environmentally safe, long lasting and effective biocontrol agents. Jasso de Rodriguez *et al.* (2007) evaluated fungal activity of Aloe vera pulp on mycelial growth of *Rhizoctonia solani* and *Fusarium oxysporum*.

The data summarized in table 1 show that *Zingiber officinale* rhizome extract in powdered form @ 40 and 50% concentrations significantly inhibited the growth of *R. bataticola*, but not completely; however, absolute inhibition was recorded in carbendazim (0.1 percent) treatments. Both chemicals performed significantly better than powdered extract at both concentrations (40 and 50 percent). The higher concentration of rhizome extract (50%) out performed the lower concentration (40 percent). An average of 18.6 mm and 8.8 mm growth was recorded in 40% and 50% rhizome extract concentrations, respectively, with a maximum of 90.0 mm growth recorded in control. Jha and Sharma (2008) screened an aqueous autoclaved leaf extract of eighty three plant species *in-vitro* for their fungicidal activity against isolates of *Rhizoctonia bataticola* by paper disc diffusion assay technique. The study revealed that only a few plant extract *viz*., *Rannunculus scleratus, Xanthium stramonium, Zingiber officinale, Ipomoea carnea, Ocimum basilicum* and *Eclipta alba* showed varied antifungal activities.

It is clear that mancozeb (0.2 percent) and carbendazim (0.1 percent) significantly inhibited the growth *of C. gloeosporioides,* but these treatments could not completely inhibit the growth. However, minimum growth was recorded in carbendazim @ 0.1 percent (0.00 mm), followed by mancozeb @ 0.2 percent (2.1mm), *Z. officinale* rhizome extract @ 50 percent concentration (8.4mm), and Carbendazim at 0.1 percent was found to be significantly more effective than mancozeb. Powdered extract at 50% was statistically significant over 40%, and both treatments were significantly superior to the control. Rajmane and Korekar (2012) screened aqueous leaf extract, medicinal plant gums, latex of medicinal plants and plant essential oils to test their fungitoxic properties against post-harvest fungi. Plant extract of *Eucalyptus angophoroides* and *Zingiber officinale* found to be fungitoxic for the growth of *Alternaria alternata, Botryodiplodia theobromae, Colletotrichum gloeosporioides, Fusarium oxysporum, Penicillium chrysogenum* and *Phoma caricae*. These result supports the result of Somda *et at*. (2007).

The data show that powdered extracts of *Z. officinale* at 40% and 50% concentrations significantly inhibited the growth of *Phoma sorghina*, but not completely, whereas mancozeb completely inhibited the growth (0.2 per cent). and carbendazim at 0.1 percent (0.00 mm), followed by a powdered extract of *Z. officinale* at 50% (10.4 mm) and a powdered extract at 40% (10.4 mm) (25.1 mm). Mancozeb and carbendazim outperformed both concentrations of rhizome powdered extract significantly. Control had the highest growth rate of 89.0 mm. Essential oils and extracts of *Azadirachta indica, Zingiber officinale,* and *Eucalyptus camaldulensis* were tested against *Fusarium moniliforme*, *Phoma sorghina*, and *Colletotrichum graminicola*, and the extent of inhibition was found to be concentration dependent (Somda *et al.,* 2007). Similarly, tulsi oil inhibited the growth of both phytopathogenic and storage fungi (Oxenham *et al.,* 2005).

Table 1: *In-vitro* efficacy of powdered extract of *Z. officinale* rhizome against different pathogens.

Treatments	*Rhizoctonia solani*	*Rhizoctonia bataticola*	*Colletorichum gloeosporioides*	*Phoma sorghina*
Powdered extract @ 40%	17.5	18.6	17.8	25.1
Powder extract @ 50%	7.5	8.8	8.45	10.4
Mancozeb @ 0.2%	3.3	3.7	2.1	0.00
Carbendazim @ 0.1%	0.0	0.0	0.0	0.00
Control	89.2	90.0	87.8	89.0
SE(m)±	**0.29**	**0.16**	**0.26**	**0.36**
CD at 5%	**0.86**	**0.49**	**0.78**	**1.07**

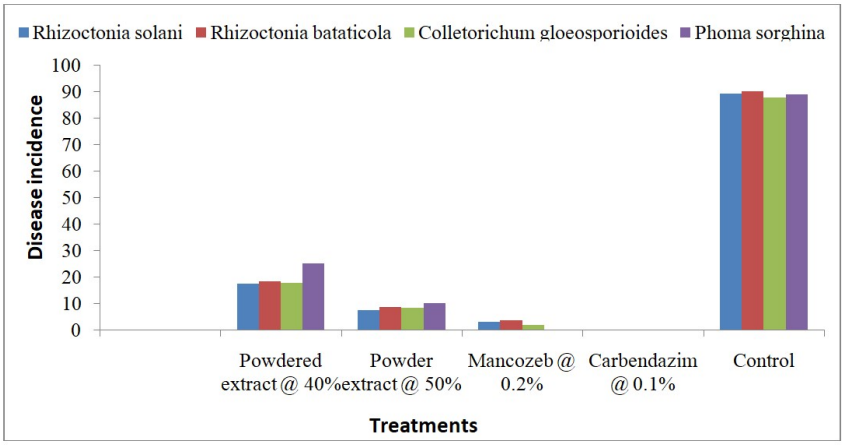

Fig. 1. *In-vitro* efficacy of powdered extract of *Z. officinale* rhizome against different pathogens.

Table 2: *In-vitro* efficacy of boiled extract of *Z. officinale* rhizome against different pathogens.

Treatments	*Fusarium pallidorosem*	*Fusarium oxysporum*	*Sclerotium rolfsii*	*Sclerotinia sclerotium*	*Alternaria solani*	*Alternaria altarnata*
Powdered extract @ 40%	20.0	24.7	23.7	26.8	22.6 22.6	20.8
Powder extract @ 50%	9.8	10.7	8.7	8.5	8.5	6.8
Mancozeb @ 0.2%	0.0	0.0	4.3	0.00	0.0	0.00
Carbendazim @ 0.1%	0.0	0.0	0.0	0.00	0.0	0.00
Control	90.0	87.9	90.0	87.7	87.7	89.2
SE(m)±	**0.16**	**0.21**	**0.19**	**0.17**	**0.21**	**0.23**
CD at 5%	**0.48**	**0.64**	**0.57**	**0.52**	**0.63**	**0.68**

The data show that *Z. officinale* rhizome extract in the boiled form at 40% and 50% concentrations significantly inhibit the growth of *F. pallidorosem*, but not completely; however, absolute inhibition was recorded in carbendazim at 0.1 percent and mancozeb at 0.2 percent. These fungicides outperformed the boiled extract of *Z. officinale* rhizome in both concentrations. The 50 percent concentration of boiled extract outperformed the 40 percent concentration. Harsh (1998) trials were carried out to control the damping-off and wilt disease of *Albizia lebbek* seedlings caused by *Fusarium pallidoroseum* by using the extracts of 8 plant (weed) species. The leaf extract of *Vitex negundo, Zingiber officinale* and plant extract of *Cuscuta reflexa* were most effective in inhibiting the conidial germination and mycelia growth of the pathogen and also in controlling the disease in field.

It is clear that *Z. officinale* rhizome extract in boiled form at 40% and 50% concentrations significantly inhibited the growth of *F. oxysporum* f. sp. *ciceri,* but it showed no growth in mancozeb (0.2 percent) and carbendazim (0.2 percent) (0.1 percent). Mancozeb and carbendazim outperformed both concentrations (40 and 50 percent) of rhizome extract. The higher concentration of boiled extract (50%) outperformed the lower concentration (40 percent). In the 50% and 40% concentrations, an average of 10.7 mm and 24.7 mm growth was observed, respectively, with a maximum of 87.9 mm growth observed in the control. Yeni (2011) the pathogenicity test showed that these six spoilage fungi: *Botryodiplodia theobromae*, *Aspergillus niger*, *Aspergillus flavus*, *Fusarium oxysporum*, *Fusarium solani* and *Rhizopus stolonifer* cause rot of yam. The test plants used were: *Allium sativum* (bulb), *Ocimum*

gratissimum (leaf), *Zingiber officinale* (rhizome) and *Nicotiana tabacum* (leaf). Result found in conformity with Shamim *et al.* (2004); Ushiki *et al*. (1996); Jasso de Rodriguez *et al.* (2007); Curir *et al*. (2005).

It is clear that boiled rhizome extract of *Z. officinale* @ 40 and 50 per cent concentrations significantly inhibited the growth of *S. rolfsii*; however Carbendazim (0.1%) absolutely inhibited the growth. Minimum growth was recorded in Mancozeb @ 0.2% (4.3mm) followed by *boiled* extract @ 50% (8.7 mm) and @ 40% (23.7 mm). The maximum of 90.00 mm growth was recorded in control. Carbendazim @ 0.1% was found significantly superior over mancozeb and both the concentrations of *Z. officinale*. The 50% concentration was significantly superior over its 40% concentration. The boiled rhizome extract of *Z. officinale* significantly inhibited the growth of *S. rolfsii*, however Carbendazim (0.1%) absolutely inhibited the growth. Carbendazim was found significantly superior over mancozeb and both the concentrations of *Z. officinale*. These finding are supported by Vasilescu *et al*. (2004); Celer (2000); Abdel- Rehim *et al*. (1987).

It is clear that *Z. officinale* boiled extract at 40% and 50% inhibited the growth of *S. sclerotium* significantly but not completely. While mancozeb @ 0.2 percent and carbendazim @ 0.1 percent (0.00 mm) showed complete inhibition, boiled extract @ 50 percent (8.5 mm) and @ 40 percent (26.8 mm). Mancozeb and carbendazim outperformed both concentrations of rhizome boiled extract significantly. Boiled extract at 50% was significantly higher than 40%. The maximum of 87.7 mm growth was recorded in control. Stangarlin *et al.* (2007) the effect of aqueous extract of ginger was evaluated at concentrations of 1, 5, 10, 15, 20 and 25% on *Sclerotinia sclerotiorum* mycelial growth and sclerodia production, *in vitro*. The efficiency of protection of ginger was also verified in lettuce plants growth organically and inoculated with the pathogen. Besides the disease incidence, the crop yield and the peroxidase induction were analyzed in the tissue plants. The results showed the antimicrobial activity of ginger with mycelial growth and sclerodia production inhibition.

The data show that *Z. officinale* rhizome boiled form at 40% and 50% concentrations significantly inhibited the growth of *Alternaria solani* but could not completely stop the growth; however, absolute inhibition was recorded in mancozeb (0.2%) and carbendazim (0.1%) treatments. Both chemicals performed significantly better than rhizome extract at both concentrations (40 and 50%). An 8.5 mm and 22.6 mm growth was recorded in 50% and 40% concentrations, respectively, while a maximum of 87.7 mm growth was recorded in control. Damping-off, Root rot and Wilt of vegetables is considered to be reused by *Fusarium solani*, *Fusarium oxysporum*, *Sclerotium rolfsii, Rhizoctonia solani, Alternaria solani, Macrophomina phaseolina and Pythium* spp. to be the most deleterious diseases (Abdel-Rehim *et al*., 1987; Celar, 2000). So far, apart from scientific and practical difficulties, there is no economic way to control the crop diseases. Plant pathogenic fungi are ubiquitous in intensive agricultural areas and are extensively controlled by using a large number of inorganic and organic chemical fungicides.

The boiled extract of *Z. officinale* at 40% and 50% concentrations significantly but not completely inhibited the growth of *A. alternata*, but no growth was observed in carbendazim at 0.1 percent (0.00 mm) and mancozeb at 0.2 percent (0.00 mm), followed by boiled extract at 50% concentration (6.8 mm) and 40% concentration (20.8 mm), with a maximum of 89.2 growth observed in control. Carbendazim at 0.1 percent and mancozeb at 0.2 percent were found to be significantly superior to both concentrations of boiled extract. According to Fawzi *et al*. (2009), boiled extract of *Z. officinale* significantly but not completely inhibited the growth of *A. alternata*, but carbendazim and mancozeb had no effect. Carbendazim and mancozeb were found to be significantly more effective than both concentrations of boiled extract.

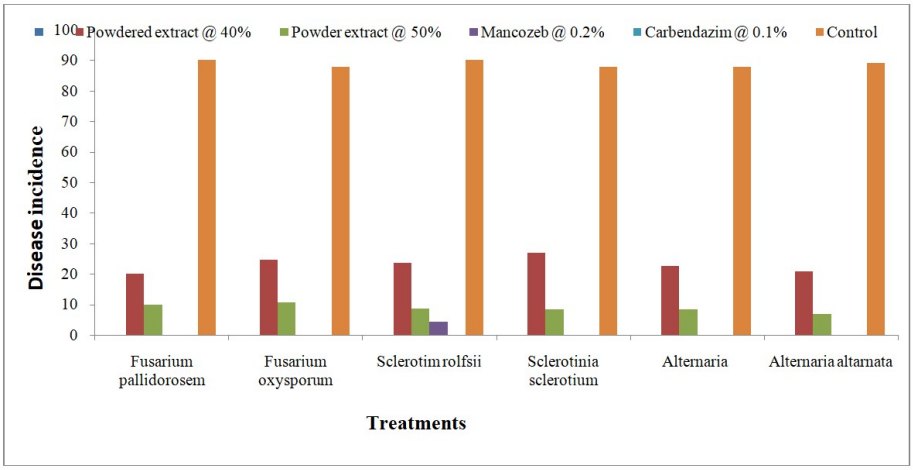

Fig. 2. *In-vitro* efficacy of boiled extract of *Z. officinale* rhizome against different pathogens.

CONCLUSION

The level of effectiveness of powdered and boiled extract against the respective fungus increased gradually as concentration increased from 20% to 50%, but complete inhibition of the respective test fungus could not be achieved even at the maximum concentration, 50%. Up to a concentration of 50%, carbendazim (0.1%) and mancozeb (0.2%) were found to be more effective than *Zingiber officinale* rhizome extract (powdered/boiled). Higher concentrations of extracts are more effective.

FUTURE SCOPE

The effective form of *Z. officinale* may also be tested in the field as an alternative to chemical for environmentally friendly disease management.

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How to cite this article: Manvendra Choudhary and Rajni Singh Sasode (2022). *In-vitro* Evaluation of Ginger (*Zingiber officinale* Rosc.) Rhizome Extract with the Recommended Chemical under different against Fungal Pathogens. *Biological Forum – An International Journal*, *14*(3): 741-745.