

Fungal Spoilage of Stored Fruits of *Carica papaya* L. and *Vitis vinifera* L. and Fungitoxicity of Plants Extracts

Research Article

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Abstract

The sample of fruits of *Carica papaya* L. and *Vitis vinifera* L. were collected from fruit vendors, fruit shops and mandies of Gorakhpur and bought to the laboratory in pre sterilized polythene bags. A total of 36 fungi associated with the fruits were isolated by standard method. Dynamics of rotting, test for pathogenicity, weight loss and per cent loss of protein, carbohydrate and phosphorus were observed. Dynamics of rotting were highest for *Corticium rolfsii* Sacc; *Lasiodiplodia theobromae* Pat; *Pestalotia bicolor* Ell and Ev; *Pestalotia foedans* Saccardo and Ellis and *Trichothecium roseum* Pers. Link. Ex: which also caused highest loss of weight, loss of protein, carbohydrate and phosphorus contents of all the fruits? Extract of 47 angiospermic plants were tested for their efficacy against *Corticium rolfsii*, *Lasiodiplodia theobromae*, *Pestalotia bicolor*, *Pestalotia foedans* and *Trichothecium roseum* by inverted plate method. *Erythrina indica* L., *Foeniculum vulgare* Mill and *Spilanthes acmella* exhibited 100 per cent efficacy. The Minimum Inhibitory Concentration (MIC) was 5000 ppm.

Keywords: Fruits; Pathogenicity; Rotting; Plant extracts; MIC

Introduction

Plants suffer severely from post-harvest diseases. These diseases develop on plant produce or plant products during harvesting, grading, packing and transportation to market up to consumers and while the produce is in possession of the consumer until the movement of actual consumption are huge. During this period plant products attacked by micro organisms show various symptoms. One of the frequently occurring symptoms is rot. In many cases micro organisms secrete toxic substances that make the remainder of the product unfit for consumption or lower its nutritional and sale values [1-5].

Fruits are an important part of our food from pre historic time. They are chief source of vitamins, minerals, protein, carbohydrate, fat,

fiber and other minor and major elements. Ripe fruits are susceptible to attack by rot micro organisms because at this stage they contain enough moisture and highest nutritional contents which make them more susceptible for the growth of fungi.

The present paper describes the rot disease of fruits of *Carica papaya* L. and *Vitis vinifera* L. caused by fungi during storage and their effect on carbohydrate, protein and phosphorus contents. The paper also describes fungitoxicity of some extracts of plant parts.

Material and Methods

Sample of fruits of *Carica papaya* and *Vitis vinifera* were collected periodically from fruit vendors, fruit shops and mandies as well as from the markets of nearby areas in pre sterilized polythene bags

and brought to the laboratory. Symptoms of disease and associated mycoflora were observed.

Isolation of the associated mycoflora

Isolation of associated mycoflora with spoiled fruits was done after their surface sterilization with 90 per cent alcohol. The isolated fungi were transferred to Czapek-Dox Agar (CDA) medium. Some isolations were made by transferring the hyphae directly from the aerial mycelium present over the surface of the infested fruits.

Petri plates were incubated at the temperature of $24 \pm 2^\circ\text{C}$. During the incubation period, petri plates were examined daily from third day of the incubation for the fungi. All the fungi, thus isolated were purified by single spore technique. The pure cultures were maintained on CDA slants at 10°C . The cultures were identified with the help of available literature.

Czapek-Dox Agar (CDA) medium was used to isolate the fungal flora and to observe its growth during the course of investigation. Potato Dextrose Agar (PDA) and Oat Meal Agar (OMA) media were used to test antifungal activity of leaf and seed extract against test fungi.

Test for pathogenicity

Pathogenicity tests were conducted to confirm the pathogenic nature of the isolated fungi on their respective hosts. Fresh and sound fruits of *Carica papaya* and *Vitis vinifera* were surface sterilized with 90 per cent alcohol to remove the superficial mycoflora as well as to maintain the natural nature of the skin of fruits. An injury of 10 mm depth was made over the surface of the fruits with the help of sterilized cork borer of 5 mm diameter. A bit of tissue was taken out and three day old inoculum was placed in the pit. The piece of the fruit tissue taken out was inserted back to its position and the wound was then sealed with the sterilized cotton.

The inoculated fruits were placed in sterilized glass jars at the temperature of $24 \pm 2^\circ\text{C}$.

The pathogenicity of the organism was considered established only when Koch's postulate was fully satisfied. For both the fruits five replicates were maintained.

Data were also recorded for the dynamics of rotting using following formula of Bottcher (1986) [6,7].

$$Y = \beta_1 (x-z)^2$$

Where,

x = duration of storage in days

Y = rot

β_1 = Linear rise

z = a period without macroscopic symptoms

Weight loss

To observe change in the weight of the fruits due to the infection caused by the pathogenic fungi, fresh and healthy fruits were surface sterilized and inoculated separately with respective pathogenic species as described above.

Similar control sets were maintained in which the pathogenic fungi were not inoculated.

Weight loss was noted after incubating the controlled and inoculated sets for a week at $24 \pm 2^\circ\text{C}$. Loss in weight was determined by following formula:

$$\text{Weight loss} = W - w / W \times 100$$

Where,

W = weight of the infested fruit before incubation

w = weight of the infested fruit incubation

Estimation of chemical constituents of fruits inoculated by test fungi

Methods of Lowry et al. (1951), Dreywood (1946) and Fiske et al. (1925) were followed to study the effect of test fungi on protein, carbohydrate and phosphorus (mineral content) respectively. Fresh fruits nearly of the same maturity were surface sterilized by 90 per cent alcohol and were inoculated separately by three day old cultures of test fungi on respective fruits. The inoculated fruits were placed in sterilized glass jars at $24 \pm 2^\circ\text{C}$ temperature for one week. Control sets of sterilized and uninoculated fruits were also prepared similarly. Protein, carbohydrate and phosphorus (mineral content) of both inoculated and uninoculated (control) fruits were estimated [8-12].

Screening of vapour of plant parts for their fungitoxicity against test fungi

Some plants belonging to different families of angiosperms were collected from Gorakhpur district. These were identified with the help of various flora.

Freshly collected parts of each plant (especially leaves and seeds) were surface sterilized by dipping in 0.1 per cent mercuric chloride as it is a good disinfectant and were then washed with sterile water. The plant parts (100 g) were crushed into pieces and macerated with 100 ml of sterile water (1:1 w/v) in mortar with the help of pestle. To obtain the extract the pulp was squeezed through a double layered muslin cloth. 2.0 mg streptopenicillin was added to the extract to prevent bacterial activity during the course of experimentation. The extract was then assayed for its volatile anti fungal activity against the test fungi by inverted plate method [13-17].

10 ml of medium was aseptically poured into each of the sterilized Petri plates of 7.5 cm diameter. One assay disc of 5 mm diameter of fungi, taken from periphery of one week old culture, was inoculated in Petri plates. The inoculated Petri plates were turned upside down. To the lower lid of the Petri plate, 5 ml of extract soaked in sterilized cotton was aseptically inoculated. A control set was prepared similarly, using cotton soaked in 5 ml of distilled and sterile water instead of filtrate. The Petri plates were incubated for six days at $24 \pm 2^\circ\text{C}$.

On the seventh day, diameter of colony of treatment as well as control sets was measured in mutually perpendicular direction. The experiment contained five replicates and was repeated thrice. All

other experiments were set likewise, unless mentioned otherwise. Percent inhibition of mycelium growth was calculated on mean value of colony diameter using the formula of Vincent (1947) [18-22].

$$\% \text{ inhibition of mycelia growth} = \frac{dc-dt}{dt} \times 100$$

Where,

dc = Average diameter of fungal colony in control sets

dt = Average diameter of fungal colony in treatment sets

Minimum Inhibitory Concentration (MIC)

Minimum inhibitory concentration was also observed by inverted Petri plate method as described above. For MIC 1 to 10 ml (1000-10,000 ppm) extract of *Erythrina indica* L., *Foeniculum vulgare* L. and *Spilanthes acmella* Murr. Soaked in sterilized cotton were introduced in the lower lid of separate petri plates. The Petri plates were incubated for six days at $24 \pm 2^\circ\text{C}$. On the seventh day, diameter of colony of treatment as well as of the control sets was measured by the formula of percent inhibition of mycelia growth.

Result and Discussion

A survey of local markets as well as of the markets of nearby areas was periodically conducted for two years. During this period a number of soft rot causing fungi were collected from the fruits of *Carica papaya* and *Vitis vinifera*. Symptoms of the diseases encountered and the morphological characters of the fungi isolated were taken into consideration for their identification. The results are given in Tables 1-6.

Out of 36 fungi isolated from fruits of *Carica papaya* and *Vitis vinifera*, 31 were associated with *Carica papaya* (Table 1). Among them 20 species, viz., *Aspergillus fumigatus*, *A. funiculosus*, *A. nidulans*, *A. ochraceus*, *A. parasiticus*, *A. tamari*, *A. terreus*, *Aspergillus* sp. U.I., *Mucor racemosus*, *Pestalotia bicolor*, *P. foedans*, *Penicillium chrysogenum*, *P. oxalicum*, Sterile mycelium black, greenish black and Sterile mycelium white are new record from this fruit. 26 fungi were observed to be associated with *Vitis vinifera* (Table 1). Among them, 21 fungi viz., *Aspergillus flavus*, *A. funiculosus*, *A. nidulans*, *A. ochraceus*, *A. sydowi*, *A. tamari*, *A. terreus*, *A. unguis*, *Aspergillus* sp. U.I., *Cladosporium herbarum*, *C. lignicolum*, *Cladosporium* sp., U.I., *Corticium rolfsii*, *Lasiodiplodia theobromae*, *Mucor racemosus*, *Pestalotia bicolor*, *P. foedans*, *Penicillium citrinum*, *P. oxalicum*, Sterile mycelium (greenish black) and *Trichothecium roseum* have not been reported earlier from this fruit.

The result in Table 1 also shows that *Alternaria alternata*, *Aspergillus flavus*, *A. niger*, *Corticium rolfsii*, *Lasiodiplodia theobromae*, *Pestalotia bicolor*, *P. foedans*, *Rhizopus stolonifer* and *Trichothecium roseum* were associated with both the fruits. However certain species were specific for any one fruit eg. *Aspergillus fumigatus*, *A. parasiticus*, *Fusarium moniliforme*, *F. oxysporum*, *F. semitectum*, *F. solani*, *Fusarium* sp. U.I., *Penicillium chrysogenum*, sterile mycelium black and sterile mycelium white were found to be associated only with fruit of *Carica papaya*. Whereas *Aspergillus sydowi*, *A. unguis*, *Botrytis cinerea*, *Cladosporium lignicolum* and *Cladosporium* sp. U.I.,

Table 1: Showing fungi isolated from fruits of *Carica papaya* L. and *Vitis vinifera* L.

Name of fungi	Fruits	
	C.p.	V.v.
<i>Alternaria alternata</i> Keissler	+	+
<i>Aspergillus flavus</i> Link	+	+
<i>A. fumigatus</i> Fresenius	+	-
<i>A. funiculosus</i> G. Smith	+	+
<i>A. nidulans</i> (Eidam) Winter	+	+
<i>A. niger</i> Van Tieghem	+	+
<i>A. ochraceus</i> Wilhelm	+	+
<i>A. parasiticus</i> Speare	+	-
<i>A. sydowi</i>	-	+
Bainier and Sartory		
Thom and Church		
<i>A. tamarii</i> Kita	+	+
<i>A. terreus</i> Thom	+	+
<i>A. unguis</i> Thom and Raper	-	+
<i>Aspergillus</i> sp. U.I.	+	+
<i>Botrytis cinerea</i> Persoon	-	+
<i>Cladosporium herbarum</i> (Persoon) Link	+	+
<i>C. lignicolum</i> Corda	-	+
<i>Cladosporium</i> sp. U.I.	-	+
<i>Corticium rolfsii</i> Sacc.	+	+
<i>Curvularia lunata</i> (Walker) Boedijn	+	+
<i>Fusarium moniliformae</i> Sheldom	+	-
<i>F. oxysporum</i> Schlecht	+	-
<i>F. semitectum</i> Berk. And Rav.	+	-
<i>F. solani</i> App. Et. Wr.	+	-
<i>Fusarium</i> sp. U.I.	+	-
<i>Lasiodiplodia theobromae</i> Pat	+	+
<i>Mucor racemosus</i> Fresenius	+	+
<i>Pestalotia bicolor</i>	+	+
Ell. And Ev.		
<i>Pestalotia foedans</i>	+	+
Saccardo and Ellis		
<i>Penicillium chrysogenum</i> Thom	+	-
<i>P. citrinum</i> Thom	+	+
<i>P. oxalicum</i>	+	+
Currie and Thom		
<i>Rhizopus stolonifer</i>	+	+
(Ehrenb ex Fr.) Lind		
Sterile Mycelium (Black)	+	-
Sterile Mycelium (Greenish Black)	+	+
Sterile Mycelium (White)	+	-
<i>Trichothecium roseum</i>	+	+
Pers. Link. Ex		

C.p. = *Carica papaya*, + = Present, - = Absent, U.I. = Unidentified, V.v. = *Vitis vinifera*

were specific for *Vitis vinifera*. The specific appearance of some fungi on any one fruit may be because of their ability to secrete different types of enzymes [19-25].

The result in Table 2 shows dynamics of rotting by different fungi during storage of fruits. For the fruits of *Carica papaya* it was highest by *Rhizopus stolonifer* (288) followed by sterile mycelium greenish black (262), Sterile mycelium black (256), *Aspergillus parasiticus* (256), *Corticium rolfsii* (250) and least by *Alternaria alternata* (38).

In case of fruits of *Vitis vinifera* dynamics of rotting was highest by *Trichothecium roseum* (172) followed by *Lasiodiplodia theobromae* (147), *Corticium rolfsii* (147), *Aspergillus niger* (137), Sterile mycelium greenish black (130) and it was least by *Penicillium citrinum* (14).

Pathogenicity test were conducted to confirm the pathogenic nature of isolated fungi on their respective hosts. The effect of pathogenic fungi on the weight of fruits was also noted. The result is given in Table 3.

Out of 31 fungi isolated from *Carica papaya*, 21 species confirmed their pathogenic nature and loss in weight was noted to be 4.78, 4.59, 4.02, 3.83, 3.82, 3.63, 3.44, 3.25, 2.87, 2.87, 2.68, 2.30, 2.29, 2.29, 2.10, 1.91, 1.91, 1.72, 1.34 and 1.34 per cent when inoculated by *Lasiodiplodia theobromae*, *Trichothecium roseum*, *Aspergillus niger*, *Pestalotia foedans*, *Penicillium citrinum*, *Aspergillus terreus*, *Corticium rolfsii*, *Aspergillus flavus*, *Mucor racemosus*, *Penicillium chrysogenum*,

Aspergillus ochraceus, *Pestalotia bicolor*, *Alternaria alternata*, *Aspergillus tamarii*, *Fusarium oxysporum*, *Rhizopus stolonifer*, *Aspergillus fumigatus*, *Curvularia lunata*, *Fusarium semitectum*, *Aspergillus nidulans* and *Fusarium moniliforme*.

The fruits of *Vitis vinifera* were infested by 26 species of which 18 species were found to be pathogenic, Loss in weight was noted to be 4.16, 4.16, 3.33, 3.33, 3.00, 2.50, 2.50, 2.00, 2.00, 2.00, 1.70, 1.66, 1.66, 1.66, 1.60, 1.50, 1.25 and 1.25 per cent when inoculated by *Aspergillus niger*, *Corticium rolfsii*, *Aspergillus flavus*, *Trichothecium roseum*, *Lasiodiplodia theobromae*, *Mucor racemosus*, *Rhizopus stolonifer*, *Aspergillus tamarii*, *Botrytis cinerea*, *Pestalotia bicolor*, *Aspergillus terreus*, *A. nidulans*, *Cladosporium herbarum*, *Pestalotia foedans*, *Alternaria alternata*, *Curvularia lunata*, *Aspergillus ochraceus* and *Penicillium citrinum*.

Table 3: Showing test for pathogenicity and weight loss of fruits by fungi during storage.

Name of fungi	Pathogenicity		Weight loss (%)	
	C.P.	V.v.	C.P.	V.v.
<i>Alternaria alternata</i>	+	+	2.29	1.60
<i>Aspergillus flavus</i>	+	+	3.25	3.33
<i>A. fumigatus</i>	+	-	1.91	0.0
<i>A. funiculosus</i>	-	-	0.0	0.0
<i>A. nidulans</i>	+	+	1.34	1.66
<i>A. niger</i>	+	+	4.02	4.16
<i>A. ochraceus</i>	+	+	2.68	1.25
<i>A. parasiticus</i>	-	-	0.0	0.0
<i>A. sydowi</i>	-	-	0.0	0.0
<i>A. tamarii</i>	+	+	2.29	2.00
<i>A. terreus</i>	+	+	3.68	1.70
<i>A. unguis</i>	-	-	0.0	0.0
<i>Aspergillus</i> sp. U.I.	-	-	0.0	0.0
<i>Botrytis cinerea</i>	-	+	0.0	2.00
<i>Cladosporium herbarum</i>	-	+	0.0	1.66
<i>C. lignicolum</i>	-	-	0.0	0.0
<i>Cladosporium</i> sp. U.I.	-	-	0.0	0.0
<i>Corticium rolfsii</i>	+	+	3.44	4.16
<i>Curvularia lunata</i>	+	+	1.91	1.50
<i>Fusarium moniliformae</i>	+	-	1.34	0.0
<i>F. oxysporum</i>	+	-	2.29	0.0
<i>F. semitectum</i>	+	-	1.72	0.0
<i>F. solani</i>	-	-	0.0	0.0
<i>Fusarium</i> sp. U.I.	-	-	0.0	0.0
<i>Lasiodiplodia theobromae</i>	+	+	4.78	3.00
<i>Mucor racemosus</i>	+	+	2.87	2.50
<i>Pestalotia bicolor</i>	+	+	2.38	2.00
<i>Pestalotia foedans</i>	+	+	3.83	1.66
<i>Penicillium chrysogenum</i>	+	-	2.87	0.0
<i>P. citrinum</i>	+	+	3.82	1.25
<i>P. oxalicum</i>	-	-	0.0	0.0
<i>Rhizopus stolonifer</i>	+	+	2.10	2.50
Sterile Mycelium (Black)	-	-	0.0	0.0
Sterile Mycelium (Greenish Black)	-	-	0.0	0.0
Sterile Mycelium (White)	-	-	0.0	0.0
<i>Trichothecium roseum</i>	+	+	4.59	3.33

C.p. = *Carica papaya*, + = Pathogenic, - = Non pathogenic, V.v. = *Vitis vinifera*, U.I. = Unidentified

Table 2: Showing Dynamics of rotting of fruits by fungi during storage.

Name of fungi	Fruits	
	C.p.	V.v.
<i>Alternaria alternata</i>	38.0	75.0
<i>Aspergillus flavus</i>	235.	51.0
<i>A. fumigatus</i>	147.0	-
<i>A. funiculosus</i>	147.0	54.0
<i>A. nidulans</i>	48.0	24.0
<i>A. niger</i>	196.0	137.0
<i>A. ochraceus</i>	192.0	122.0
<i>A. parasiticus</i>	256.0	-
<i>A. sydowi</i>	-	103.0
<i>A. tamarii</i>	147.0	93.0
<i>A. terreus</i>	173.0	90.0
<i>A. unguis</i>	-	83.0
<i>Aspergillus</i> sp. U.I.	146.0	89.0
<i>Botrytis cinerea</i>	-	32.0
<i>Cladosporium herbarum</i>	37.0	25.0
<i>C. lignicolum</i>	-	54.0
<i>Cladosporium</i> sp. U.I.	-	19.0
<i>Corticium rolfsii</i>	250.0	147.0
<i>Curvularia lunata</i>	133.0	72.0
<i>Fusarium moniliformae</i>	240.0	-
<i>F. oxysporum</i>	196.0	-
<i>F. semitectum</i>	201.0	-
<i>F. solani</i>	206.0	-
<i>Fusarium</i> sp. U.I.	172.0	-
<i>Lasiodiplodia theobromae</i>	211.0	147.0
<i>Mucor racemosus</i>	249.0	128.0
<i>Pestalotia bicolor</i>	108.0	24.0
<i>Pestalotia foedans</i>	132.0	123.0
<i>Penicillium chrysogenum</i>	144.0	-
<i>P. citrinum</i>	64.0	14.0
<i>P. oxalicum</i>	90.0	54.0
<i>Rhizopus stolonifer</i>	288.0	128.0
Sterile Mycelium (Black)	256.0	-
Sterile Mycelium (Greenish Black)	262.0	130.0
Sterile Mycelium (White)	243.0	-
<i>Trichothecium roseum</i>	152.0	172.0

C.p. = *Carica papaya*, - = Absent, V.v. = *Vitis vinifera*, U.I. = Unidentified

From the Table 4 it may be noticed that the protein content of *Carica papaya* decreased up to 0.19, 0.14, 0.11, 0.08 and 0.06 per cent when it was inoculated by *Lasiodiplodia theobromae*, *Trichothecium roseum*, *Pestalotia foedans*, *Corticium rolfsii* and *Pestalotia bicolor* respectively. The percentage of carbohydrate decreased up to 4.08, 2.16, 1.68, 1.32 and 1.08 per cent when inoculated by *Lasiodiplodia theobromae*, *Corticium rolfsii*, *Pestalotia bicolor*, *P. foedans* and *Trichothecium roseum* respectively and the percentage of phosphorus decreased up to 7.0, 5.0, 3.0, 3.0 and 1.0 per cent when inoculated by *Pestalotia foedans*, *Lasiodiplodia theobromae*, *Pestalotia bicolor*, *Trichothecium roseum* and *Corticium rolfsii* respectively [26].

In *Vitis vinifera* the loss in protein content was noted to be 0.32, 0.27, 0.22, 0.14 and 0.11 percent when inoculated with *Trichothecium roseum*, *Lasiodiplodia theobromae*, *Pestalotia foedans*, *P. bicolor* and *Corticium rolfsii* respectively, the percentage of carbohydrate decreased up to 7.38, 4.50, 1.38, 1.26, and 0.42 per cent when inoculated by *Pestalotia foedans*, *Corticium rolfsii*, *Trichothecium roseum*, *Lasiodiplodia theobromae* and *Pestalotia bicolor*. Loss in phosphorus content was up to 22, 20, 10, 6.0 and 2.0 per cent when inoculated by *Lasiodiplodia theobromae*, *Pestalotia foedans*, *P. bicolor*, *Trichothecium roseum* and *Corticium rolfsii* respectively.

The result of screening of vapors of plant parts (leaves and seeds) given in the Table 5. The plant species are grouped alphabetically under their respective families.

It is evident from the data in Table 5 that aqueous extracts of different parts of 46 plant species belonging to 34 families of angiosperms screened against test fungi, most of the species showed either poor (below 50%) or moderate (above 50%) activity. *Erythrina indica* L., *Foeniculum vulgare* L. and *Spilanthes acmella* Murr, were found to exhibit absolute toxicity against test fungi [27].

It is clear that extract of *Erythrina indica*, *Foeniculum vulgare* and *Spilanthes acmella* after in vivo studies may be used for the

Table 4: Showing comparative percent loss of chemical constituents by test fungi.

Name of fungi	Content(%)	C.p.	V.v
<i>Corticium rolfsii</i>	P	0.08	0.11
	C	2.16	4.50
	Ph	1.00	2.00
<i>Lasiodiplodia theobromae</i>	P	0.19	0.27
	C	4.08	1.26
	Ph	5.00	22.0
<i>Pestalotia bicolor</i>	P	0.06	0.14
	C	1.68	0.42
	Ph	3.00	10.0
<i>Pestalotia foedans</i>	P	0.11	0.22
	C	1.32	7.38
	Ph	7.00	20.0
<i>Trichothecium roseum</i>	P	0.14	0.32
	C	1.08	1.38
	Ph	3.00	6.00

C.p. = *Carica papaya*, P = Protein, Ph = Phosphorus, V.v = *Vitis vinifera*, C = Carbohydrate

Table 5: Showing screening of vapours of extracts of some plants for their activity against mycelial growth of test fungi.

Plants	Percent inhibition of mycelial growth				
	C.r.	L.t.	P.b.	P.f.	T.r.
<i>Abutilon indicum</i> (L.) Sweet (Malvaceae)	71	39	60	65	78
<i>Adenocalyma alliceae</i> Mart ex Meisser (Bignoneaceae)	86	98	77	56	66
<i>Ageratum conizoides</i> L. (Asteraceae)	60	26	68	52	39
<i>Antigonon leptopus</i> Hook & Arn (Polygonaceae)	46	31	54	68	55
<i>Azadirachta indica</i> A. Juss (Meliaceae)	53	55	56	39	40
<i>Bauhinia variegata</i> L. (Caesalpiniaceae)	21	19	29	14	28
<i>Boerhaavia diffusa</i> L. (Nyctagenaceae)	51	31	29	14	45
<i>Brassica campestris</i> L. (Brassicaceae)	26	20	27	18	34
<i>Callistemon lanceolatus</i> DC. (Myrtaceae)	38	47	78	10	10
<i>Cannabis sativa</i> L. (Cannabinaceae)	40	13	18	31	34
<i>Cassia occidentalis</i> L. (Caesalpiniaceae)	11	21	15	22	16
<i>Cassia tora</i> L. (Caesalpiniaceae)	16	18	13	44	23
<i>Cleom viscosa</i> L. (Capparidaceae)	21	20	18	29	14
<i>Commelina benghalensis</i> L. (Commelinaceae)	19	20	44	22	32
<i>Convolvulus minor</i> Hort. (Convolvulaceae)	20	15	29	38	18
<i>Cuscuta reflexa</i> Roxb. (Cuscutaceae)	20	36	35	44	43
<i>Erythrina indica</i> L. (Fabaceae)	100	100	100	100	100
<i>Eucalyptus citriodora</i> Hook. (Myrtaceae)	56	59	92	30	38
<i>Euphorbia hirta</i> L. (Euphorbiaceae)	43	25	81	49	5
<i>Euphorbia pulcherrima</i> Willd. Ex. Koltz (Euphorbiaceae)	30	35	24	22	43
<i>Foeniculum vulgare</i> Mill. (Apiaceae)	100	100	100	100	100
<i>Gomphrena globosa</i> L. (Amaranthaceae)	31	12	11	32	40
<i>Helicteres ixora</i> L. (Sterculiaceae)	26	18	38	29	31
<i>Heliotropium indicum</i> L. (Boraginaceae)	70	63	64	59	88
<i>Hibiscus rosa sinensis</i> L. (Malvaceae)	25	0	18	31	63
<i>Lindenbergia indica</i> (L.) Kuntze (Scrophulariaceae)	27	22	13	18	20
<i>Mangifera indica</i> L. (Anacardiaceae)	24	13	12	10	33
<i>Melia azadirachta</i> L. (Meliaceae)	28	20	44	27	35
<i>Mirabilis jalapa</i> Jacq. (Nyctaginaceae)	38	36	41	56	43
<i>Morus alba</i> L. (Moraceae)	13	40	39	14	20
<i>Murraya koenigii</i> (L.) Sprang (Rutaceae)	82	77	43	50	59
<i>Nerium indicum</i> Mill (Apocynaceae)	60	58	40	56	47
<i>Nicotiana plumbaginifolia</i> Viv. (Solanaceae)	12	20	29	24	39
<i>Oxalis corniculata</i> L. (Oxalidaceae)	29	10	20	23	18
<i>Papaver somniferum</i> L. (Papavaraceae)	17	55	16	23	26
<i>Phyllanthus niruri</i> L. (Euphorbiaceae)	26	66	20	30	14
<i>Ranunculus scleratus</i> L. (Ranunculaceae)	10	3	29	24	50
<i>Ricinus communis</i> L. (Euphorbiaceae)	13	0	67	24	20
<i>Rosa sinensis</i> Jacq. (Rosaceae)	21	47	36	44	35
<i>Ruellia tuberosa</i> L. (Acanthaceae)	86	60	78	64	79
<i>Scoparia dulcis</i> L. (Scrophulariaceae)	19	21	16	22	29
<i>Sida acuta</i> Burm.f. (Malvaceae)	25	20	28	18	17
<i>Solanum nigrum</i> L. (Solanaceae)	15	16	12	23	30
<i>Spilanthes acmella</i> Murr. (Asteraceae)	100	100	100	100	100
<i>Tridax procumbens</i> Jacq. (Asteraceae)	27	28	17	23	30
<i>Triumpheta rhomboidea</i> Jacq. (Tiliaceae)	83	64	72	75	78
<i>Xanthium strumarium</i> L. (Asteraceae)	64	43	65	71	50

C.r: *Corticium rolfsii*, L.t.: *Lasiodiplodia theobromae*, P.b.: *Pestalotia bicolor*, P.f.: *Pestalotia foedans*, T.r.: *Trichothecium roseum*

Table 6: Showing minimum inhibitory concentration of the extracts of *Erythrina indica*, *Foeniculum vulgare* and *Spilanthes acmella* against test fungi.

Extract	Concentration (ppm)	Percent inhibition of mycelial growth				
		C.r.	L.t.	P.b.	P.f.	T.r.
<i>Erythrina indica</i>	10000	100	100	100	100	100
	9000	100	100	100	100	100
	8000	100	100	100	100	100
	7000	100	100	100	100	100
	6000	100	100	100	100	100
	5000	100	100	100	100	100
	4000	93	90	95	93	96
	3000	83	86	87	83	89
	2000	54	44	63	59	54
<i>Foeniculum vulgare</i>	10000	100	100	100	100	100
	9000	100	100	100	100	100
	8000	100	100	100	100	100
	7000	100	100	100	100	100
	6000	100	100	100	100	100
	5000	100	100	100	100	100
	4000	89	95	91	88	93
	3000	76	64	80	71	67
	2000	43	49	50	41	54
<i>Spilanthes acmella</i>	10000	100	100	100	100	100
	9000	100	100	100	100	100
	8000	100	100	100	100	100
	7000	100	100	100	100	100
	6000	100	100	100	100	100
	5000	100	100	100	100	100
	4000	97	90	93	93	97
	3000	82	79	83	83	86
	2000	64	58	57	66	51
	1000	33	26	21	28	23

C.r.: *Corticium rolfsii*; L.t.: *Lasiodiplodia theobromae*; P.b.: *Pestalotia bicolor*, P.f.: *Pestalotia foedans*; T.r.: *Trichothecium roseum*

preservation of fruits during storage. However the active ingredient and its isolation need further attention. The anti fungal activity of the extract against *Lasiodiplodia theobromae*, *Corticium rolfsii*, *Pestalotia bicolor*, *Pestalotia foedans* and *Trichothecium roseum* is being reported for the first time.

Conclusion

Some healthy plants and their parts show antifungal and microbial activity because they have some naturally occurring substances which play an effective role in plant disease resistance. A few of these substances have been purified, characterized and exploited in phyto-chemotherapy.

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