EVALUATION OF GARLIC (*ALLIUM SATIVUM*) AND UZIZA (*PIPER GUINEENSE*) ON THE CONTROL OF TUBER ROT FUNGI OF POTATO AND CARROT

Amaeze, N. J., Ezeh, P. A. and Dan-kishiya, A. S.

Department of Biological Sciences, University of Abuja, Nigeria
E-mail: ngoziamaeze@yahoo.com.sg

ABSTRACT

Tuber rot in potato and carrot are major diseases occurring wherever potatoes and carrots are grown. This study investigated the control of tuber rot fungi of potato and carrot using extracts from garlic (*Allium sativum*) and uziza (*Piper guineense*). The following fungi; *Aspergillus niger, Aspergillus flavus, Fusarium solani* and *Geotrichum candidum* were isolated from rotted potato tubers while *Fusarium solani, Fusarium oxysporium, Geotrichum candidum* and *Rhizoctonia carotae* were isolated from rotted carrots. The pathogenicity test conducted showed that these organisms caused rots of potato and carrots. Aqueous extracts of garlic and uziza suppressed fungal growth and reduced rot development in the infected potato tubers and carrots. The highest percentage inhibition of 91.70% was obtained with the use of *P. guineense* extract on *G. candidum* on potato tubers while in Carrot 87.06% was obtained with a mixture of extracts from *P. guineense* and *A. sativum* on *F. oxysporium* . The use of extracts from *A. sativum* and *P. guineense* has great potentials in extending the shelf life of potato and carrot.

Key words: Potato, carrots, Tuber rot, shelf life, *Allium sativum, Piper guineense*

{**Citation:** Amaeze, N. J., Ezeh, P. A. and Dan-kishiya, A. S. Evaluation of Garlic (*Allium Sativum*) and uziza (*Piper Guineense*) on the control of tuber rot fungi of potato and carrot. American Journal of Research Communication, 2013, 1(9): 167-174} www.usa-journals.com, ISSN: 2325-4076.

INTRODUCTION

Irish potato is one of Nigerian staple foods. It is a very rich source of starch and it has a high calorific value. The carrot is widely known as a vegetable that is easy to grow, delicious and highly nutritious. Though potatoes and carrots are very cheap in the production areas, they are relatively more expensive in other urban cities and this is due to lack of adequate transportation and preservation techniques in the country. Tuber rot in potato and carrot are major diseases occurring wherever potatoes and carrots are grown. Most of these rots cause substantial reduction in yield or quality (Zitter and Loria, 2002) and losses in transit and storage particularly in the warm regions where temperature is high and there are no facilities available for cold storage (Bdliya and Dahiru, 2006). Tuber rot in potato and carrot is caused by a variety of bacteria and fungi each causing its own type of rot. In potato the evident rots are the dry rot cause by *Fusarium spp*, soft rot by *Erwinia caratovora*, pink rot by *Phytophthora erythroseptica* and ring rot by *Corynebacterium sepedonicum* and in carrots are soft rot, dry rot and crater rot cause by *Rhizoctonia carotea* while sclerotina rot is cause by *Sclerotina sclerotiorum*, and gray mould rot by *Botrytis cinerea*. The activities of these microorganisms lead to the changes in appearance, deterioration of texture and possibly flavour or taste of the potato or carrot (Amienyo and Ataga, 2007).

Recent studies on the use of plant extracts have opened a new opportunity for the control of tuber diseases. *Allium sativum* and *P. guineense* are widely used in the control of clinical microbial isolates but rarely used on fungi associated with tuber rot in potato and carrot. The aim of this study is to carry out an evaluation of *A. sativum* and *P. guineense* in the control of tuber rot fungi of potato and carrot.

MATERIALS AND METHODS

Sample collection

Rotted potato tubers and carrots were collected from Gwagwalada market, Abuja. These were packaged in polyethylene bags and taken to the microbiology laboratory in University of Abuja immediately. *A.sativum* (bulb), *P. guineense* (seed), healthy potato tubers and carrots used for this study were purchased from the same market. Samples were selected and placed on the shelf to rot.

Isolation of organisms

Samples were washed with clean water and the diseased portion of the potato tuber and carrot were cut under aseptic condition into small bits into a sterile dish with the aid of sterile scissors (Ijato, 2011). The cut diseased bits were sterilized with 70% ethanol were then placed on Sabouraud Dextrose Agar (SDA) plates. The inoculated plates were then incubated at room temperature (28°C) for 7 days. The fungal colonies grown on the incubated plates were sub-cultured into fresh plates of SDA until pure culture was obtained. Microscopic examination was used after examining the colony characteristics for identification.

Pathogenicity test

Fresh, healthy potato tubers weighing 40±2g and carrots weighing 52±1g were washed with tap water, rinsed with distilled water and surface sterilized with 70% ethanol. Cylindrical discs were removed from the tuber with a sterile 4 mm cork borer. A disc of a five days old culture of the isolated fungi was transferred into holes created in the tubers, Vaseline was used to completely seal each side and pieces of cotton were placed on the Vaseline. The inoculated tubers were placed in separate airtight containers and incubated for 14 days at room temperature (28 ± 2°C). The same procedure was used for the control except that discs of uninoculated PDA were placed in the holes created in the tubers (Amienyo and Ataga, 2006). After incubation period of 14 days at room temperature, the tubers were examined for infection and disease development.

Preparation of plant extracts

Allium sativum (bulb) and *P. guineense (*seed) were dried and grounded separately. Thirty grams of each sample was added into 15 ml of distilled water in separate flasks. This was vigorously stirred and left to stand for 24 h. The sample was filtered with a whatman filter paper (No.1) and the filtrate used as the extract. 10ml of each extract was added into 90ml of sterile distilled water to make 10% of the extract. For 10% mixture of *A. sativum* and *P. guineense* extract, the extract was made up of 5ml of *A. sativum* extract and 5ml of *P. guineense* extract.

Effect of plant extract on rot development

The method of Udo *et al.* (2001) was used to determine the effect of extract on rot development. Freshly harvested healthy potato tubers and carrots were washed with water and surface sterilized with 70% ethanol. The potato tubers and carrots were divided into four (4) groups. The first group was soaked in 10% *A. sativum* extract, the second group in 10% *P. guineense* extract, the third group in 10% mixture of *A. sativum and P. guineense* extract, the fourth group was used as the control and was soaked in sterile distilled water and all were allowed to stand in the solution for 3 min. The potato tubers and carrots were removed from the extract and distilled water (for control) and incubated at room temperature for 24 hour. Using a 4mm cork borer, discs were removed from the treated tubers and replaced with 4mm discs of a 5 day old culture of each test fungi. Vaseline jelly was used to completely seal each hole. The inoculated potato tubers and carrots were placed in sterile sealed containers and incubated at room temperature (28 ± 2^0C) for 14 days. After the incubation period, the potato tubers and carrots were incised horizontally with sterile knife. The length of 'unrottened' portion from each hole was measured over the total surface length with a metre rule. Percentage inhibition was obtained using the expression below.

$$\% \text{ inhibition} = \frac{\text{length of 'unrottened' portion}}{\text{Total surface length}} \times 100$$

Statistical analysis

The treatments were subjected to variance analysis (one-way ANOVA) via an SPSS. Mean separations were carried out using Duncans Multiple Range tests (DMRT) at $P < 0.05$.

RESULTS AND DISCUSSIONS

Fungal isolates

The fungal organisms isolated from the samples of rotten potatoes were identified as *Aspergillus niger, Aspergillus flavus, Fusarium solani* and *Geotrichum candidum* while fungi isolated from rotten carrots were *Fusarium oxysporium, Fusarium solani, Geotrichum*

candidum and *Rhizoctonia carotae* which were reported to be implicated in tuber rots (Amienyo and Ataga, 2007).

Pathogenicity test

The pathogenicity test on the fungi when inoculated into healthy potato tubers and carrot showed that these isolated fungi can induce rot (Table 1). The most virulent of these fungi was *G. candidum* which destroyed the tubers completely within six days than *A. Flavus*, *A. Niger* and *Fusarium spp.*

Table 1: Pathogenicity test on Potato and Carrot

Isolates	Potato			Isolates	Carrot		
	A	B	C		A	B	C
A. niger	+	+	+	*F. solani*	+	+	+
A. flavus	+	+	+	*F. oxysporum*	+	+	+
G. candidum	+	+	+	*G. candidum*	+	+	+
F. solani	+	+	+	*R. carotae*	+	+	+
Control	-	-	-	Control	-	-	-

* Positive (+) negative (-): pathogenicity test result was positive for the fungi isolates and negative for the control.

Effect of plants extracts on tuber rots fungi

The treated potato tubers and carrots when inoculated with the respective test fungi and treated with the plants extracts, the degree of reduction or protection of the tubers from rot by the plant extracts varied and was highly significant ($p<0.05$) after incubation as shown in Table 2. The highest rot reduction in potato was seen with *P. guineense* which showed 91.70% reduction on *G. candidum* than *A. Sativum* (81.76%) on *F. solani.* A combination of *P. guineense* and *A. Sativum* also reduced potato tuber rot (84.47%) while *A. flavus* was the least susceptible to the extracts. However, there was no significant difference on the activities of all the extracts on *A. flavus.* The present result is similar with the findings of Okigbo *et al.* (2009) who recorded high rot reduction (62.80%) with *A. sativum* and also Udo *et al* (2001) reduced the growth and

sporulation of fungal pathogens on sweet potato and yam with garlic (*Allium sativum*).

Table 2: Average percentage (%) inhibition of tuber rot on Potato and Carrot

Potato isolates	Extracts		
	P. guineense	*A. sativum*	*P. guineense* + *A. sativum*
A.niger	78.86a	72.56b	67.12c
A. flavus	49.58a	44.34a	41.62a
F. solani	66.52b	81.76a	84.47a
G.candidum	91.70a	62.27b	63.14b
Control	0	0	0
Carrot isolates			
F. solani	64.59b	85.61a	82.08a
F. oxysporum	57.37b	83.57a	87.06a
G. candidum	83.65a	62.50b	67.58b
R. carotae	71.93a	62.50b	76.93a
Control	0	0	0

* Mean of data with the same letter on the same row are not significantly different by DMRT at P = 0.05

The highest rot reduction in carrot (87.06%) was observed with the combination of *P. guineense* and *A. sativum* on *F. oxysporium* than *A. sativum* on *F. solani* (85.61%). However all the extracts reduced rot of Carrot caused by *R. carotae* greatly with no significant difference and also *A. sativum* with a combination of *P. guineense* and *A. sativum* reduced rot of Carrot with no significant difference. However the lowest rot reduction was observed with *P. guineense* on *F. oxysporum* while the control recorded highly significant unlimited rot development. Studies by Ilondu and Iloh (2007) and also Eruteya and Odunfa (2009) have also confirmed that extracts of *P. guineense* prevented the growth of the fungi such as *A. Niger, Rhizopus stolonifer, Fusarium solani, Colletritichium sp., Pythium sp.* and *Cladosporium herbarium.*

The present study showed that *A. sativum* and *P. guineense* both have fungitoxic substance and potential to protect Potato and Carrot against rot fungi especially rot caused by

G. candidum with a synergetic effect on *F. oxysporum* of Carrot by combining the two extracts. Several other works have confirmed the antimicrobial activity of garlic against a broad spectrum of fungal and bacterial organisms (Shashikanth *et al*., 1981; Gondwe *et al*., 1996; Shenge, 2002; Amodu, 2006). The antimicrobial properties of garlic have been attributed to the presence of an essential oil that contains allyl disulphide (C6H2 S2) diallyl disulphide (C6 H10 S2) and two or more sulphur-containing compounds (Shenge 2002; Obagwu, 2003).

The use of synthetic fungicides can be harmful to both farmers and the environment. This problem can be prevented by the use of biological methods which can provide an alternative way of reducing and controlling rot of tubers as it is less expensive, economically safe, non phytotoxic and easy to prepare.

REFERENCES

Amienyo, C. A. and Ataga, A. E. (2006). Post harvest fungal diseases of sweet potato (*Ipomoea batatas L.Lam*) tubers sold in selected markets in Rivers state, Nigeria. *Science Africa*, *5*(2): 95-98.

Amienyo, C. A. and Ataga, A. E. (2007). Use of indigenous plant extracts for the protection of mechanically injured sweet potato [*Ipomoea batatas* (L.) lam] tubers. *Scientific Research and Essay*, *2*(5):167-170.

Amodu, U. S. (2006). Bacterial soft rot of tubers induced by Erwinia spp. M.Sc Thesis, Faculty of Agriculture, Ahmadu Bello University, Zaria. 67.

Bdliya, S. B. and Dahiru, B. (2006). Efficacy of some plant extracts on the control of potato tuber rot caused by *Erwinia carotovora* sp. *Carotovora. Journal of plant protection research.* 46(3): 285-294.

Eruteya, O.C. and Odunfa, S. A. (2009). Anti microbia properties of three spices used in the preparation of Suya condiment against organisms isolated from formulated samples and individual ingredients. African *Journal of Biotechnology*. 8: 2316-2320.

Gondwe, B. R., Mabagala, R. and Femi. L.A. (1996). Effect of garlic extracts on growth of *Pseudomonas syringae* pv. *Phaseolicola* in culture media. *Bean Improvement Cooperative Report* 29: 280-281.

Ijato, J. Y. (2011). Antimycotic effects of aqueous and ethanol plant extracts on yam rot pathogens in Ado-Ekiti, Nigeria. *Academia Arena, 3*(1):115- 11.

Ilondu, E. M. and Iloh, A. C. (2007). Inhibition of three fungal isolates from sorrel drink (Zobo) using hurdle technique. *World Journal of Agricultural Sciences*, 3: 339-343.

Obagwu. J. (2003). Developing Biopesticides for control of citrus fruit pathogens of importance in Global trade. Ph. D. Thesis, Faculty of Natural and Agricultural Sciences, University of Pretoria. 166.

Shashikanth, K. N., Basapa, S. C. and Murthy, V.S. (1981). Studies on the antimicrobial and stimulatory factors of garlic (*Allium sativum*) *Journal of food science and technology*. India. 18(2): 44-47.

Shenge, K. C. (2002). Evaluation of plant extracts for the control of bacterial blight of cotton induced by *Xanthomonas compestric* PV. Malvacearum (Smith) Dye. M.Sc theses Ahmadu Bello University Zaria. 79.

Udo, S. E., Madunagu, B. E. and Isemin, C. D. (2001). Inhibition of growth and sporulation of fungal pathogens on sweet potato and yam by garlic extracts. *Nigeria Journal of Botany, 14*: 35-39.

Zitter, A.T. and Loria, R. (2002). Detection of potato tuber diseases and defects. *Information bulletin* 205, Cornell University.