

Microbial effects on Rain fed and Irrigated Tomatoes (*Lycopersicon esculentum* Mill) Cultivated in Bassa Local Government Area of Plateau State, Nigeria.

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Abstract

Tomatoes (*Lycopersicon esculentum*) are a major dietary source of antioxidants particularly lycopene which has much health benefits like reduced risk of health disease and cancer. Microorganisms are noted to be major limiting factors in the production of tomatoes. This study is thus aimed at determining microorganisms associated with tomato fruit yield in irrigated and rain fed systems. The soil, tomato fruit and tomatoes leaves were randomly sampled. Bacteria were identified using various biochemical tests while fungal isolates were screened using cotton blue in lactophenol stain and with the aid of a fungal chart. Bacteria such as *Bacillus* sp., *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella aerogenes* and *Sarcinae* were isolated. Some fungi seen were *Aspergillus* sp., *Scelosponium aposperum*, *Curvularia* sp., *Arthrographis skalrae*, *Neosartorya fischeri* but *Saccharomyces cerevisiae* appeared most (49.00%) in rain the rain fed system whereas *Staphylococcus aureus* was most frequent (50.00%) in the irrigated system. Higher yield of tomatoes (31,925kg) was obtained in irrigated system as compared to 7,250kg harvested in the rain fed system. The variety UTC gave a better yield and showed higher resistance than EKA variety. Thus, it may be preferable to adopt the Irrigated system and use of the UTC variety in this study area.

Key Words: Rain fed, irrigated system, tomato varieties, microbes, yield

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I. Introduction

Tomato (*Lycopersicon esculentum* Mill) belongs to the family, Solanaceae. It is the major fruit and vegetable crop cultivated globally. The usage of tomato fruits in food produces healthy diets that have potential to reduce the risk of diseases like cancer, osteoporosis and cardiovascular disease. It has been opined that people who used to eat tomatoes regularly have a reduced risk of increased cholesterol level, heart disease, blood pressure, cell damage, and blood sugar (Kumar *et al.*, 2020). Ozmen *et al.* (2016) and Bayramoglu *et al.* (2013) documented that bioactive molecules present in tomato are known to be effective in diabetes as lycopene has been reported to exert hypoglycemic effects by increasing serum insulin levels and lowering glucose levels in diabetic animals induced by streptozotocin.

It is said to be rich in nutrients, vitamins, dietary fibers, protein, essential amino acids, monounsaturated fatty acids, carotenoids, phytosterols and phytochemicals (Elbadraw and Sello, 2016; Abdullahi *et al.*, 2016; Ramos *et al.*, 2017; Chaudhary *et al.*, 2018; Krug *et al.*, 2020). Economically, it is a very profitable crop that provides high returns for small scale farmers in most developing countries like Nigeria. As a result of its nutritive value, taste, affordability, and accessibility, there has been an increase in demand by consumers. It is an annual plant classified as a warm season crop. Its optimum temperature for germination is ideally grown in deep fertile humus rich; free draining but moisture retentive soils which are free of nematodes.

Due to the morphology of tomato, it is prone to both fungal and bacterial infections. As it has been reported that in most developing countries, microbial infestation of tomatoes can occur during the harvesting period, post-harvesting, handling, storage, transportation, and processing by customers. The proliferation of bacteria in tomatoes, most especially in damaged tomatoes could be considered to be more harmful when such contaminated tomatoes are consumed in improperly cooked food (Krug *et al.*, 2020). One of the limiting factors that influence tomato economical value is its relatively short shelf life caused by pathogen attack (Onuorah and Orji, 2015). Ghosh (2009) had reported that fungi were the source of spoilage of most of the tomato samples

accessed than bacteria. Baker (2006) also isolated *Aspergillus niger* from rotten tomato fruits and reported that they are pathogenic on tomato fruits.

Tomato is among the vegetables that thrive excellently on the Plateau. This vegetable is grown all year round by irrigation during dry season and by rain water during the rainy season. Therefore, the aim of this research was to determine the effect of microorganisms on the yield in rain fed and irrigated grown tomatoes.

II. Materials And Method

Preparation of Test Sample

The samples were taken to the laboratory; the spoiled portion was picked with forceps and was homogenized in a cleaned mortar and pestle. Further sample solution preparations were done by serial dilution method with the following respective concentrations; 10^{-1} , 10^{-2} , 10^{-3} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , 10^{-9} .

Preparation of culture media

Different sterilized culture media (nutrient agar, potato dextrose agar and eosin methylene broth media) were prepared aseptically to support the growth of microorganisms basically for bacteria and fungi by autoclaving as per standard.

Isolation and screening of pure culture

From the sterile prepared 100ml conical flask, 20ml of different nutrient media were transferred aseptically to petri plates and allowed to cool on a sterilized bench and a wire loop full culture from different diluted samples solution was streaked on petri plates. The plates were then incubated at 37°C for 48 hours. The above procedure was repeated to get pure microbial strains and the organisms were preserved on their culture medium under aseptic standard. Identification and classification of the fungal isolates was based on macroscopic and microscopic examination. The macroscopic examination was carried out by observing the colonial characteristics especially the colour formation of both the front and reverse sides of the plates as adopted by Obunukwu *et al.*(2018).Microscopically, a drop of lactophenol cotton blue solution was placed on a clean grease-free slide and fragment of the fungal isolate was emulsified in the solution thereafter viewed under the microscope (Obunukwu *et al.*, 2018).The fungal isolates were then identified with the aid of mycological atlas.

III. Results

The bacteria isolated from the study area in association with tomato fruits, roots, leaves and the soil include *Bacillus subtilis*, *B.cereus*, *B. aureus*, *Staphylococcus aureus*, *Pseudomonas aerogenes*, *P. aeruginosa*, *Klebsiella aerogenes*. However, the fungal isolates were *Aspergillus niger*, *Rhizopus* species, *Saccharomyces cerevisiae*, *Alternaria alternate*, *Curvularia species*, *Arthrographis kalrae*, *Blastomyces dermatidis*, *Absidia corymbifera*, *Sceclosporium aposperum*, *Fonsecaea pepadrosi* and *Penicillium* species (Table 1 and 2). The results also revealed that *Bacillus subtilis*(28.33%) is most associated with tomato followed by *Klebsiella aerogenes*(17.50%) in rainy season.. However, *Staphylococcus aureus* has the highest percentage occurrence of 10.00% while *Sariciriae* and *Bacilli* have lowest percentage of occurrence of 4.00% and 3.00% respectively in the irrigation system(Table 1).Tomato yields were greater in irrigated system of farming than rain fed system(31925kg > 7,250kg) (Table 3).

Table 1. Frequency of Bacterial isolates in Rain Fed and Irrigation System

Bacteria in Rain Fed	Frequency	% Frequency
<i>Bacillus subtilis</i>	34	28.33
<i>Bacillus cereus</i>	9	7.50
<i>Bacillus aureus</i>	17	14.17
<i>Staphylococcus aureus</i>	7	5.83
<i>Pseudomonas aeruginosa</i>	8	6.67
<i>Klebsiella aerogenes</i>	21	17.50
	96	80
Bacteria in Irrigation System	Frequency	% Frequency
<i>Bacilli</i>	4	3.33
<i>Fusiform bacilli</i>	2	1.67
<i>Staphylococcus aureus</i>	12	10.00
<i>Sariciriae</i>	3	2.50
Filamentous bacilli	3	2.50
	24	20

Table 2. Frequency of Fungal isolates in Irrigated System and Rain Fed

Irrigated System	Frequency	% Frequency
<i>Aspergillus niger</i>	12	15.38
<i>Rhizopus sp</i>	8	10.26
<i>Penicillium sp</i>	6	7.69
<i>Saccharomyces cerevisiae</i>	25	32.05
	51	65.38%
Rain Fed	Frequency	% Frequency
<i>Aspergillus niger</i>	3	3.85
<i>Curvularia sp</i>	3	3.85
<i>Arthrograhis kalrae</i>	3	3.85
<i>Neosartorya fischeri</i>	3	3.85
<i>Aspergillus flavus</i>	6	7.69
<i>Aspeergillus fumigatus</i>	3	3.85
<i>Secelosporium asposperum</i>	3	3.85
<i>Fonsecae pepdrossoi</i>	3	3.85
	27	34.64%

Table 3. Tomato Variety, Type of Farming and Yield (kg)

Location	Rain	Fed	Irrigated	System
	Variety	Total yield (kg)	Variety	Total yield (kg)
Amo district	EKA	5,925	UTC	23,675
Jere district	UTC	975	UTC	6,750
Buhit district	UTC	350	UTC	1,500
Grand total		7,250kg		31,925kg

IV. Discussion

Ibrahim *et al.* (2011) isolated *Aspergillus niger* as one of the major fungi responsible for the production of volatile compounds in spoiled tomatoes. In the current study also the genus *Aspergillus* was the most diverse of fungal genus associated with tomato fruits. Nevertheless, in terms of occurrence, this result is slightly different from the findings of Akinmusire (2011) and Ibrahim (2011), who reported that *A. niger* had the highest rate of occurrence in tomato fruits whereas in this study, *Saccharomyces cerevisiae* had the highest, having occurrence of 32.05% than *A. niger* with 15.3% in the Irrigated system.

Baker (2006) also isolated *Aspergillus niger* from rotten tomato fruits and reported that they are pathogenic on tomato fruits. Akinmusire (2011) reported that *Rhizopus spp* were associated with the spoilage of tomatoes. Wogu and Ofuase (2014) isolated *Aspegillus spp*, *Penicillum spp*, *Fusarium spp* and *Saccharomyces spp* from spoiled tomato fruits conforming with the isolates screened in this study. Mbajiuka and Enya (2014) also isolated *Aspergillius spp*, *Penicillum spp* and *Saccharomyces cerevisiae* from spoiled tomatoes while Fatih *et al.* (2011) reported the presence of *Alternaria alternata* and *Fusarium oxysporum* in the spoiled tomato fruits they studied. Ghosh (2009) also isolated *A. niger* and *Rhizopus stolonifer* from the spoiled tomato fruits studied which is similar to this present finding.

It is noted here that there are more constant bacterial population in the irrigated system when compared to the rain fed system (Table 3) likely due to the controlled application of water which may lead to reduced risk of bacterial diseases because of decreased soil moisture fluctuation and reduced rain splash.

Fungal spoilage of tomatoes is attributable to the high water content, environmental conditions, state of handling, state of storage facilities, the fungal load of the handlers and the quality of the tomatoes. The fungi isolated in this study are sources of potent mycotoxins which are detrimental to health. For instance, *A. niger* is a source of ochratoxin which is considered to be a potent carcinogen; therefore spoiled tomatoes must not be consumed but disposed off, since such consumption could be detrimental to health.

The higher frequency of *Bacillus sp.* in rainy season cultivation indicates possible faecal contamination as a result of human activities aided by run-off water. Their presence could have caused root or crown rots resulting to plant death thus a decrease in tomato fruit yield.

The tomato fruit yield was greater in the irrigated system (31,925kg) than in the rain fed (7,250kg), could likely be due to the fact that the dry season favours the local varieties because the nights are cooler as a result of lower mist in the air whereas growing the fruit in the wet season becomes difficult because heat is trapped in the moisture and the soil temperature is high making the varieties that farmers have difficult to cultivate

In conclusion, the irrigated system of tomato cultivation should be highly encouraged due to its higher yield when compared to the rain fed system. Furthermore, variety wise UTC is better adopted in this study area due to its higher yield and possible resistance to diseases.

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