The Effect of Washing with Water and Detergent on Increasing the Shelf Life of Pepper (*Capsicum Annum*) on Sale at Rimi and Tarauni Markets of Kano State, Nigeria

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Abstract

Sample of pepper was collected from two selected vegetable markets and used to determine the most effective method of increasing shelf life of pepper. In the research two treatment methods used by marketers of vegetables washing with water and detergent were compared. The results showed that five fungal colonies were isolated from pepper samples obtained from the study aeas. The five fungal colonies isolated from the two markets have the following frequency of occurrence A. niger 17 (28.3 %) A. fumigatus 12 (23.3%), R. stolonifer 12 (20.0%), A. flavus 09(15.05%) and Mucor spp 08 (13.3%). Out of the total 60 fungal colonies isolated in the two markets, more colonies were counted from water wash pepper 37 (61.0%), while lower colony counts were recorded from detergent washed pepper in the two locations 23 (38.3%). It is clear therefore that, this investigation has established fewer fungal colonies counted from detergent washed samples in the two markets is that washing of pepper with detergent is more effective in increasing the shelf life of pepper by removing the surface contaminant micro-organisms.

Keywords: *Fungal pathogens, Detergent, Pepper, Water, Washing*

INTRODUCTION

A member of the family *solanacea* Pepper (*Capsicum annum*) is an important food source and cash especially the northern part of the Nigeria and many countries in the tropics (Alao 2000). The pepper is important in the diet being one of the major source of vitamins A, C, E, B1, B2 and D (Sani and Alao 2006; Ewekeye *et al*. 2013). In addition potassium, phosphorus, and calcium. Peppers are also obtained from pepper . In many part of the world pepper is used in making vegetable curry, salad etc. in addition pepper has some medicinal values and is used to prepare medications against fever and paralysis (Yahuza and Yahaya 2015). Olawoye

(2000) reported response of sweet pepper to measures of conservation such as evapotranspiration losses from the soil are reduced, were the plants maximize the use of available moisture, which assist them to reduce dropping of fruits (Ayanda *et al*. 2013; Yahaya *et al*., 2015). Nigeria like other tropical countries has availability of fertile land which supports good harvest. Nigeria is among the countries with good record of harvest of vegetables such as pepper, tomato, onions, okra and other vegetables that are grown in various agro-ecological zones which extend from humid areas from the Southern Nigeria to sub-humid areas in the middle belt and semi-arid/arid areas in the Northern Nigeria . The research conducted by Yahaya *et al*. (2016) indicated that crop production in Nigeria is seasonal with a glut at the season and then scarcity at off seasons. Losses of produce occur at an alarming rate of 30-50% every year because of their soft texture they are easily damaged due to poor harvesting, and other post-harvest handling operation such as packaging, transportation and storage (Al-hindi *et al*. 2011) . In the markets damaged peppers are usually mixed with fresh ones which predisposes them to attack by pathogens consequently decreasing their shelf life causing losses of production. Yahaya *et al*., (2016) showed that the long and complex chain of vegetable marketing between the grower and consumer makes the honest assessment of the losses of crops and vegetables in Nigeria difficult. However, despite all the challenges still there is the need to preserve the vegetables to make it available year round there by reducing global food epidemics. Also results of the previous studies by Alao (2000) has showed that for a country to achieve self-sufficiency in food, there is the need to put in place all strategies for increasing crop production (Mustapha and Yahaya, 2006 ; Kutama *et al*. 2007). The method of washing pepper is highly important in reduction of contamination after harvest by washing away the surface pathogens which might cause spoilage thereby reducing the post-harvest losses of the commodity (Babalola *et al*. 2010; Hernandez-Brenes, 2002a). Yahuza and Sani (2015) study on comparism between water washing and detergent washing on reduction of losses of tomato after harvest and found that lower colonies were counted on tomato washed with detergent. Therefore, the present research was an attempt to determine the most suitable washing methods that will increase the shelf life and reduce losses of harvested pepper due to infection by fungal pathogens. Two hypotheses were tested. The first washing pepper with detergent will increase the shelf life of pepper than washing with water. Second isolation and identification of the fungal pathogens that are associated with losses of pepper at Rimi and Tarauni markets of Kano State, Nigeria.

MATERIALS AND METHODS

Sampling Area
Rimi Market: - Is situated at Gwale Local Government Area of Kano State. It is among the major vegetables markets in Kano State. However, despite being among the leading markets in Kano State, it lacks good storage facilities. Therefore, marketers store their vegetables either in basket or on rusted basins. They rarely apply chemicals on their vegetables.

Tarauni Market: - Is situated at Tarauni local government area of Kano State. It is also one of big vegetables selling market in Kano State. The market lacks good storage facilities also marketers by spreading on the floor of the store or packed in rusted basins. Markets do not apply chemicals on their stored vegetables.

EXPERIMENTAL PROCEDURES

The research was done to obtained information on the infection of pepper by fungal pathogens at the two selected markets with the aimed of determining the best treatment method that will increase the shelf life of pepper and reduce postharvest loss. The investigation period was from April, 2021 to June, 2021.

DETERMINATION PATHOGENIC FUNGI CAUSING LOSSES OF PEPPER
The research was done to determined pathogenic fungi associated with losses of pepper in the market. In the research method similar to the one used Yahuza and Yahaya (2015) and Yahaya *et al.* (2016) was adopted and used..

SAMPLE COLLECTION
Six pepper were collected directly from vegetable sellers each at Tarauni and Rimi Markets twice a week and carried to the laboratory at Biology Department, Yusuf Maitama Sule University in polyethylene bags for plating.

SAMPLE HANDLING
Pepper obtained from Tarauni and Rimi Market was divided into two one half were washed with autoclave water and then allowed to dry. While the other half were washed with detergent water and allowed to dry. Using sterilized clean scalpel a (2mm) cut was made on both the water and detergent washed pepper then was placed separately on PDA plate. There after the plates were incubated at $25 - 27^0$c for three days.

COLONY COUNT AND ITS SUBCULTURE
The growth of the colonies was monitored on daily basis. The number of colonies that appeared was noted counted and recorded. Each distinct isolates was subcultured into fresh PDA.

COLONY COUNT AND SUBCULTURE
In each week, growth of fungal colonies was monitored and the number of colonies that appeared was recorded. There after individual colonies were sub cultured into fresh PDA plates and incubated.

PATHOGENICITY TEST
For pathogenicity tests diseases free pepper was surface sterilized with 10% (v/v) sodium hypochlorite solution the pepper was then washed three times under changes of running tap and water and left on laboratory bench to dry. The pepper was then streaked with fungal hyphae. For the controls the pepper was streaked with drops of sterile distilled water. The experimental set up were then left on the bench. On the fourth day using clean and sterilized forceps portions was removed from the infected areas and mounted on freshly prepared plates containing PDA and incubated.

MICROSCOPIC EXAMINATION
For the microscopic examination using clean and sterilized inoculating loop a fungal mycelium was streak on a clean glass slide. A drop of indicator cotton blue lacto phenol was placed on the fungal mycelium then cover slip was gently placed. The prepared slide was then observed under microscope at magnification of x10 and x40. The morphological characteristics of isolated fungal colonies was determined following the procedure developed by Dorothea, *et al.* (1976). Photographs of the isolated colonies was taken from microscope using camera attached to the microscope.

STATISTICAL ANALYSIS

One way analysis of variance (ANOVA) was used to analyzed the data were all the differences among the means was determined at P ≤ 0.05 for significance.

RESULTS

At the end of the research 60 fungal colonies uwere isolated counted and recorded from the two treatments. Fungal colonies that were used during the pathogenicity test were similar to ones isolated at the end of the test. Water washed pepper from both Rimi and Tarauni showed a colony count of 37 (62.0 %). In the detergent washed pepper from both the two markets a colony count of 23(38.3%). Four fungal colonies were confirmed (Table 6), *A. niger, A. fumigatus, A. flavus, R. stolonifer and Mucor.* The following composition was determine from the identified five fungal colonies *A. niger,* 17(28.3 %), *A. fumigatus* 14 (23.3 %), *A. flavus* 09 (15.0 %), *R. stolonifer* 12 (20.0 %) and *Mucor* 08 (13.3 %).

Influence of isolation Days on the Number of Isolated Colonies from the two markets

No significant difference was found between the number of colonies isolated from the two markets on Monday and Thursday.

It is clear that high number of colonies were counted on Thursday 31(52.0%) and while least colonies were counted on Monday 29 (48.0%) during the period of study (Table 1).

Table 1: Total number of fungal colonies counted from the two treatment in the two locations

Location	Rimi	Tarauni	Total	Mean	% abundance
Monday	13	16	29	14.5	48.00
Thursday	21	10	31	15.5	52.00
Total	34	26	60	30.0	100

Effect of location on the number of fungal colonies counted from the two treatments in the two locations

Although more colonies were counted from water wash and detergent wash pepper obtained from Rimi 34 (57.0%) as compare to water wash and detergent wash pepper obtained from Tarauni 26 (43.0%) but the differences was not significant. However, with regard to the treatment methods more colonies were counted on water wash pepper 37 (61.0%) while the detergent wash pepper has the least counted colonies 23 (38.0%) during the period of study (Table 2).

Table 2: Fungal colonies counted from the two treatments in the two selected markets

Location	Water washed	Detergent washed	Total	Mean	%
Rimi	21	13	34	17	57.0
Tarauni	16	10	26	13	43.0
Total	37 (61.0%)	23 (38.3%)	60	30	100

Isolated fungal colonies from water wash pepper in the two selected markets

Five colonies were obtained as fungal pathogens concerned with the losses of water wash pepper in the two selected markets. The composition of the isolated fungal colonies was *A. niger* was the most commonly occurring colony and has the percentage occurrence of 10 (27.0%), *A. fumigatus* 09 (24.32%), *R. stolonifer* 08 (21.62%) while *A. flavus* and *Mucor* are the lowest occurring colonies each with 05 (13.0%) (Table 3).

Table 3; Total number of fungal colonies isolated from water washed pepper collected from the two selected markets

Colonies	water washed Rimi	water washed Tarauni	Total	Mean	% abundance
A. niger	08	02	10	5	27.0
A. flavus	03	02	05	2.5	13.00
A. fumigatus	05	04	09	4.5	24.32
R. Stolonifer	06	02	08	4	21.62
Mucor	02	03	05	2.5	13.00
Total	24	13	37	18.5	98.94

Fungal colonies counted from Detergent washed pepper in the two selected markets
Five fungal colonies were counted and identified as the fungal pathogens concerned with the losses of water washed pepper in the two selected markets. The composition of the counted fungal colonies was found as *A. niger* as the most commonly occurring colony with frequency of occurrence of 07 (30.40%), *A. fumigatus*   05 (22.0%) while *R. stolonifer* and *A. flavus* have the same frequency of occurrence of 04 (17.3%) while *Mucor* was the lowest occurring colony with 03 (13.0%) (Table 4).

Table 4: Total number of colonies counted from detergent washed pepper obtained from the two locations

Colonies	Detergent washed Rimi	Detergent washed Tarauni	Total	Mean	% abundance
A. niger	05	02	07	3.5	30.4
A. flavus	03	01	04	2	17.3
A. fumigatus	03	02	05	2.5	22.0
R. Stolonifer	02	02	04	2	17.3
Mucor	-	03	03	1.5	13.0
Total	13	1 0	23	11.5	100

Comparism of the Number of colonies obtained from both the two treatments in both Rimi and Tarauni markets
The results of the research indicated that *A. niger* was the highest occurring colony in the both Rimi and Tarauni markets with colony counted as 17 (28.3 %) followed by *A. fumigatus* with 14 (23.3%), *R. stolonifer* with 12 (20.0%). Then *A. flavus* 09 (15.0%), while *Mucor* was the lowest occurring fungal colony in the two selected markets 08 (13.0%) (Table 5).

Table 5: Comparism of the number of fungal colonies obtained from the two treatments in the two selected markets

Colonies	Water wash Rimi	Detergent washed Rimi	Water wash Tarauni	Detergent washed Tarauni	Total	Mean	%
A. niger	08	05	02	02	17	8.5	28.3
A. flavus	03	03	02	01	09	4.5	15.0
A. fumigatus	05	03	04	02	14	7	23.3
R. Stolonifer	06	02	02	02	12	6	20.0
Mucor	02	-	03	03	08	4	13.3
Total	24	13	13	10	60	30	99.9

Table 6: Shows morphological and colonial characteristics of identified fungal spp from water washed and Detergent washed pepper collected from Rimi and Tarauni markets

s/n	Appearance on PDA	Morphological characteristics	Organism Identified
1.	The colony grows rapidly black colour reverse is is colourless or yellow later black.	Many mycelia, conidia and conidiophores black, spherical to oval head of conidia is globose splitting into columns.	*Aspergillus niger*
2.	Colony grow fast Velvet in texture, white at First later blue green to dark green. The lower is part is colourless or yellow	Conidiophores was smooth greenish upward to form apical flask shaped vesicle. Conidia green mass and, globose, rough, mainly2.5-3m in diameter.	*A. fumigatus*
3.	Colony grow flat granular, with radial grooves, initially yellow but becoming bright to dark Yellow-green .	Head of conidia typically radiate, later form loose columns (mostly 300-400um in diameter), biseriate with some heads having Philalides borne on the vesicle.	*A. flavus*
4.	Colony grows very fast white cottony initially, later brownish black at maturity.	The stolons creeping, and recurve to the substrate. as hyphae, which are strongly raised and far from the substrate. .	*R. stolonifer*

DISCUSSION

The study showed that a total of 60 fungal colonies were isolated from the two treatments. Out of which five fungal species comprising *Aspergillus niger, A. fumigatus , A. flavus* and *Rhizopus stolonifer* were obtained from the two markets. More colonies were counted from water washed pepper than detergent washed pepper in the two markets. In addition high number of fungal colonies were counted from pepper sample collected from Rimi market than pepper sample collected from Tarauni market. More colonies were counted from water wash sample of both the two markets 37 (61.0%), than detergent wash 23 (38.3%). (Table 2). Colonies counted from water wash pepper of Rimi has more colonies than 24 (64.86%) than colonies counted from Tarauni which were wash with water 13 (35.13%) this is followed by *A. fumigatus* 5 (22.0%).

Total number of 13 (56.5%) fungal colonies was isolated from the detergent washed pepper sampled from Rimi market. While 10 (43.47%) were isolated from detergent wash pepper collected from Tarauni market (Table 2 and 4). Identical fungal colonies were isolated from water wash pepper from the two markets they consist of *Aspergillus niger*, *Aspergillus fumigatus*, *Aspergillus flavus*, *Rhizopus stolonifer* and *Mucor.* Out of the colonies isolated *A. niger* was the highest occurring colony 17 (28.3%) followed by *A. fumigatus* 14 (23.3%) and *R. stolonifer* 6 (20.0%) and *A. flavus* 9 (15.0%) while the least occurring colony was *Mucor* 8 (13.3%). Similarly, colonies isolated from detergent wash pepper in the two markets were also identical to the colonies isolated from water wash pepper. Out of the colonies *A. niger* was

the highest occurring colony with 7 (30.4%) while *A. flavus* and *R. stolonifer* have same frequency of occurrence each with 4 (17.3%).the least occurring colony was *Mucor* 3 (13.0%). (Table 4). The result of the present study could be compare with the results obtained by Yahuza and Yahaya (2015) who investigated the effect of washing with water and detergent on reduction of postharvest losses of tomato on sale at Yankaba and Tarauni markets of Kano state , Nigeria and found that less fungal colonies were isolated from detergent wash tomato than water wash tomato. The finding is also similar to the results obtained by Hayatu (2000) who isolated *A. niger, A. flavus, R. stolonifer* and *Mucor spp* from sample of pepper collected from Nassarawa Local Government of Kano State, Nigeria. The finding of this research could also be related to the result of Kuku *et al.* (1980) who studied mould deterioration of some vegetables in northern Nigeria and found that 60% of losses in tomato and pepper was attributed to the activities of *A. niger* while *A. fumigatus* and *Rhizopus stolonifer* accounted for 30% and 10% respectively.

Therefore, from the result of the study it can be concluded that higher number of fungal colonies was isolated from water wash pepper than detergent wash pepper. Therefore, this is an indication that washing pepper with detergent is more effective in reducing fungal colonies from the surface of the pepper which consequently reduces postharvest losses of the pepper. Therefore, it is recommended that washing of pepper with detergent after harvest should be encouraged in the market to increase the shelf life of the produce.

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