



INVESTIGATION ON THE EFFECT OF POSTHARVEST PATHOGEN ON TOMATO QUALITY AND FARMERS IN SOME SELECTED LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA

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ABSTRACT

The study examined the effect of Post-harvest pathogen on tomato quality and farmers livelihood in Adamawa State, Nigeria. Random Sampling Technique was used in selecting of 180 respondents from the study area. Data were collected through the administration of structured questionnaire and analyzed using both descriptive and inferential statistics. The results revealed that majority (72%52%) of the respondents were male and fell within the age bracket of 31-50 years. The results also showed that majority(61.3%) of respondents were aware of fungal pathogen infestation while (23.1% and 15.6%), were aware of bacterial and viral, respectively. The results further revealed that 38.9% and 33.3% of the respondents reported yield losses of more than 30 baskets due to pathogen infestation and use open baskets for transportation. Results show that while farmers widely recognize spoilage as a critical problem primarily caused by fungi they lack detailed knowledge of specific pathogens and modern storage practices. The study concluded that respondent's demonstrated awareness of fungal tomato spoilage but remain largely uninformed about bacterial and viral threats. The study recommends the provision of affordable storage technology, investment in storage infrastructure, and evidence based policy interventions.

Keywords: Tomato, Postharvest, Losses, Pathogens, Storage, Livelihood

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a main vegetable crop that belongs to the *Solanaceae* family. It considered the first food vegetables worldwide, in a total harvested area (5,051,983 hectares), producing 189 million Mg; total cultivated area in Egypt was about 150,109 hectares with a total productivity of 6.73 million Mg and an average yield of 41.6 tons/ha in 2021 (FAOSTAT 2023). As a great worth crop, tomatoes are important revenue source for farmers; it is also a rich source of nutrients, beta-carotene, flavonoids, folate, ascorbic acid and many medicinal health benefits, which play a significant role in human health (FAO 2021). It is largely cultivated, and the consumption rate is globally due to its nutritional content, it is referred to as the "the poor man's orange" because it is rich in vitamin C, marlin and citric acids and also cheap in its price (Abdalla *et al.*, 2020). The fruit injuries as fungal deteriorations have been assessed to be more than 90 % throughout harvesting and marketing (Bayoumi *et al.*, 2023). Fungal contamination of many agricultural products, including tomatoes starts in the field. The biological and physical damages occur mostly during harvest and transportation phases. The combination of large amount of water and a soft endocarp makes tomatoes more susceptible to spoilage by fungi (Onuorah and Orji, 2015). Different strategies as fungicides, resistant hybrids, and cultural practice are generally used as commercial strategies to prevent postharvest diseases. However, the use of fungicides intensively may help pathogen to be resistant as well as fungicides released to the environment (Bakade *et al.*, 2022); however, it may represent environmental and health hazards (Wu *et al.*, 2023). Therefore, its application is becoming more limited in order to the consumer's anxieties and the human health importance (Wu *et al.*, 2023). Tomato production in Nigeria is normally at its peak due to its economic and nutritional value, which



helps most rural and urban dwellers as a means of obtaining excellent quality food nutritive additives. However, due to poor harvesting techniques, pathogen infestation, and lack of processing infrastructure, losses have been taking a high toll. As a result, reducing food losses decreases food importation enhances availability of food, thus, increasing the welfare of tomato farmers (Balana *et al.*, 2022).

Inadequate effort has been made to decrease crop loss due to pathogen infestation, such as tomatoes, but significant resources have already been invested on vegetable cultivation, irrigation, fertilizer application, and crop safety standards (Ayandiji *et al.*, 2011). Reduced post-harvest food losses result in increased total availability of food, less food import, and improved farmer wellbeing. (Abimbola, 2014). Recent studies highlight that (30–50%) of tomatoes in sub-Saharan Africa are lost during postharvest (Mok *et al.*, 2020; Bayoumi *et al.*, 2023). Fungal pathogens such as *Aspergillus* spp., *Alternaria* spp., and *Fusarium* spp. are major contributors to spoilage, while bacterial and viral pathogens also play significant roles. However, farmers' perceptions and knowledge often lag behind scientific evidence, leading to poor management. Similar surveys across Africa (Onuorah & Orji, 2021; Wu *et al.*, 2023) confirm gaps in awareness and infrastructural limitations. Different strategies as fungicides, resistant hybrids, and cultural practice are generally used as commercial strategies to prevent postharvest diseases. The use of fungicides intensively may help pathogen to be resistant as well as fungicides released to the environment (Bakade *et al.*, 2022); however, it may represent environmental and health hazards (Wu *et al.*, 2023). Therefore, its application is becoming more limited in order to the consumer's anxieties and the human health importance (Wu *et al.*, 2023). The specific objective of this work is to identify the specific pathogen associated with tomato deterioration.

MATERIALS AND METHODS

The Study Area

The survey was conducted in selected tomato-producing local government areas of Adamawa State, Nigeria. Adamawa State is located in the northeastern part of Nigeria, lying approximately between latitudes 7°N and 11°N and longitudes 11°E and 14°E. The state shares an international boundary with Republic of Cameroon to the east and borders Borno, Gombe, and Taraba States within Nigeria. The local government includes Fufere latitude 9°26'67"N and longitude 12°56'67"E, Song latitude 9°33'33"N and longitude 12°63'33"E, Maiha latitude 9°78'33"N and longitude 13°21'67"E, Mubi (North/south) latitude 10°26'70"N and longitude 13°26'70"E, Numan latitude 9°46'67"N and longitude 12°03'33"E and mayo-belwa latitude 8°85'00"N and 12°05'00"E respectively. The state lies within the Guinea savannah ecological zone, characterized by tropical climate, seasonal rainfall, and fertile alluvial soils suitable for vegetable production. The state experiences a tropical climate with two distinct seasons. The rainy and dry season. Annual rainfall ranges from about 700mm in the northern parts to approximately 1,600mm in the southern regions. Temperatures vary between 25°C and 40°C depending on the season. The major occupation of the respondents in the surveyed area is farming.

Sampling Technique and Sample Size

A descriptive survey design was employed. Structured questionnaires were administered to tomato farmers. Respondents were selected randomly from farmer associations. The criteria for selecting the farms were based on accessibility, availability of farmer on the farms or escort on the farms and the willingness of the farmer to allow sample collection from their farms. A total of one hundred and eighty farmers were interviewed. (Thirty 30 farmers in each local government.

Data collection and Analysis

Data were collected through the administration of structured questionnaire to 180 tomato farmers across the selected local government areas in Adamawa State. The questionnaire covered demographic data, awareness of pathogens, storage practices, and economic losses. Data were



analyzed using descriptive statistics such as frequency distribution, percentage and mean. Inferential statistics (Chi-square tests) were applied to assess relationships between awareness levels and socio-economic variables.

RESULTS AND DISCUSSION

Demographic Profile of the Respondents

The results show that tomato farming is male-dominated, with farmers in their productive age groups. Most respondents have at least primary or secondary education, which suggests moderate capacity to adopt improved practices. Awareness of fungal pathogens is high, consistent with literature indicating that fungi are the most visible cause of spoilage (Bayoumi *et al.*, 2023). However, the poor recognition of viral pathogens suggests a gap in farmer knowledge that requires targeted extension services.

Yield loss data reveal that a majority of farmers experience losses exceeding (30%), confirming the heavy economic burden reported by (Balana *et al.* 2022). Storage practices remain traditional, with limited adoption of refrigeration. This aligns with (Wu *et al.* 2023), who identified lack of infrastructure as a critical barrier to postharvest management in developing regions.

Table 1: Demographic Profile of the Respondents

Variables	Frequency	Percentage (%)
Sex		
Male	130	72.2
Age		
Female	50	27.8
18–30 years	40	22.2
31–50 years	95	52.8
51+ years	45	25.0
Education		
No education	30	16.7
Primary	50	27.8
Secondary	65	36.1
Tertiary	35	19.4

Awareness of Postharvest Pathogens

This study reaffirmed that postharvest tomato losses are pressing challenges influenced by interplay of socio-economic, environmental, infrastructural, and technological factors. Notably, the male-dominated farming demographic, combined with moderate educational levels, offers a foundation for the adoption of advanced practices, although knowledge of pathogens beyond fungi remains limited as it's also reported by (Wu *et al.*, 2023).

Table 2: Awareness of Postharvest Pathogens

Pathogen Type	Awareness (%)	Rank
Fungal pathogens	61.3	1
Bacterial pathogens	23.1	2
Viral pathogens	15.6	3

Yield Loss due to Pathogen Infection

Yield losses exceeding (30%) come in line with reports of (Mok *et al.*, 2020; Balana *et al.*, 2022) that nearly (40%) of farmers mirror regional trends in sub-Saharan Africa. The predominant use



of open baskets and jute bags accelerates spoilage, and minimal refrigeration use reflects persistent infrastructural and financial constraints stated by (Bayoumi *et al.*, 2023).

(FAO, 2021) state that beyond storage, inefficiencies in transportation networks, delayed market access, and insufficient sorting practices exacerbate spoilage rates. Climate-related stress manifesting as heat and rainfall variability further weakens resistance to pathogens (Abdalla *et al.*, 2020; Wu *et al.*, 2023). Food safety is compromised by infection from mycotoxin producing fungi such as *Aspergillus*, posing both health and economic risks (Wu *et al.*, 2023).

Recent global advances offer promising mitigation strategies. A five-year global review (2019–2023) identified effective postharvest treatments such as calcium chloride, chitosan coatings, gum Arabic, and Moringa seed extract, along with packaging improvements and evaporative cooling methods that significantly preserve tomato quality explain by (Bwade *et al.*, 2024).

Innovative cooling technologies have also emerged. A pilot study in Uganda tested a charcoal cooling blanket an affordable, passive evaporative system that reduced ambient temperature, controlled weight loss, and extended shelf life by up to 60% (Felicioni, 2024).

Strategic frameworks emphasizing multi-stakeholder collaboration across the tomato value chain engaging farmers, traders, transporters, and processing actors have shown success in Tanzania; such frameworks address loss due to climate, market information deficits, and inadequate infrastructure and can be adapted to Nigeria's context (Izdori *et al.*, 2025).

Environmentally friendly biocontrol solutions are gaining traction. In Egypt, the use of bacterial antagonists like *Bacillus* spp. has effectively suppressed postharvest pathogens like *Geotrichum candidum* and *Alternaria alternata*, offering safer alternatives to chemical fungicides (Wu *et al.*, 2023). Therefore, addressing tomato postharvest losses requires a multifaceted approach integrating farmer education, improved storage and cooling technologies, natural bio control methods, and robust stakeholder collaboration. Such an approach will build resilience, reduce losses, and reinforce food security.

Table 3: Reported Yield Loss due to Pathogen Infection

Yield Loss	Frequency	Percentage (%)
<10 baskets	20	11.1
10–20 baskets	40	22.2
21–30 baskets	50	27.8
>30 baskets	70	38.9

Table 4: Storage Practices used by Farmers

Storage Method	Frequency	Percentage (%)
Open baskets	60	33.3
Jute bags	50	27.8
Wooden crates	25	13.9
Refrigeration	15	8.3
Immediate sale	30	16.7



CONCLUSION AND RECOMMENDATIONS

The study concluded that respondents demonstrated awareness of fungal tomato spoilage but remain largely uninformed about bacterial and viral threats. With many reporting losses over. These losses may be due to lack of modern storage methods, weak infrastructure, and fragmented value chains. In view of that the recommended that provision of affordable storage technology adoption should be a proven solutions and multi-stakeholder collaborations to improve infrastructure, market access, and decision-making.

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