COMPARATIVE STUDY OF FUNGI ISOLATED AND IDENTIFIED ON GINO AND SONIA CANNED TOMATOES

by

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Abstract

*Tomato (*Lycopersicum esculentum*) is an important vegetable cultivated and consumed worldwide due to its nutritional value and culinary versatility. However, despite processing and preservation, canned tomato products remain prone to microbial contamination, particularly by fungi, which can adversely affect food safety, shelf life, and consumer health.This study aimed to isolate and identify fungal species present in two commercial brands of canned tomatoes (Gino and Sonia) and to compare the types of fungi detected in each brand to evaluate their potential health and safety implications. Standard microbiological techniques were used for fungal isolation and identification. Samples from both brands were cultured on Potato Dextrose Agar (PDA) and incubated at 37°C for 48 hours. Fungal colonies were examined for their macroscopic and microscopic features, and identification was performed using established morphological criteria.*

Two fungal species were isolated and identified. Aspergillus flavus *was observed in the Gino sample, characterized by greenish colonies with unbranched conidiophores, while* Rhizopus stolonifer *was identified in the Sonia sample, showing white colonies that turned grey with broad, non-septate hyphae. The detection of* A. flavus*, known for its production of aflatoxins, indicates potential health risks to consumers, while* R. stolonifer *contributes to product spoilage and quality degradation. The presence of* A. flavus *and* R. stolonifer *in canned tomatoes demonstrates that fungal contamination can persist despite industrial canning processes, possibly due to post-processing exposure or inadequate storage conditions. Such contamination compromises food quality and safety, underscoring the need for stringent quality control measures, effective sterilization, and proper storage practices. Ensuring the microbiological safety of canned tomato products aligns with sustainable food production goals and global efforts to reduce foodborne risks in line with the United Nations Sustainable Development Goals (SDG 2 and SDG 12).*

Keywords: Fungi, Tomatoes, Spoilage, Isolation, Identification, Food Safety, Mycotoxins

1. INTRODUCTION

Tomato (*Lycopersicum esculentum*) is one of the most economically and nutritionally important vegetables cultivated and consumed worldwide [1]. Conceptually, a "vegetable" refers to an edible part of a plant consumed as part of a savory meal rather than as a dessert; however, from a botanical perspective, the tomato is classified as a fruit because it develops from the ovary of a flower and contains seeds [2]. This dual identity (vegetable in culinary use and fruit in botanical classification) illustrates the complex intersection of biology, culture, and nutrition that defines the tomato's global relevance. Its significance extends beyond diet; tomatoes play a crucial role in agricultural economies, food industries, and public health due to their accessibility, affordability, and nutrient density [3].

Nutritionally, tomatoes are a rich source of essential vitamins and minerals [4]. They contain vitamin C, an antioxidant that supports immune function and skin health; vitamin K, which contributes to blood coagulation and bone metabolism; and several B vitamins that facilitate energy production and cellular repair [5]. Tomatoes are abundant in minerals such as potassium and magnesium, both of which are vital for maintaining cardiovascular and neuromuscular function [4]. From a biochemical perspective, tomatoes are particularly notable for their high concentration of carotenoids, especially lycopene [6]. Lycopene is a potent antioxidant responsible for the red coloration of ripe tomatoes, and numerous epidemiological and clinical studies have linked it to reduced risks of chronic diseases such as cardiovascular disorders, prostate cancer, and metabolic syndromes [7]. The bioactive compounds in tomatoes thus position them as functional foods; foods that provide health benefits beyond basic nutrition; making them a critical component of global dietary recommendations [8].

However, despite their nutritional and economic importance, tomatoes are highly perishable commodities. Conceptually, food spoilage refers to any alteration in food that renders it undesirable or unsafe for human consumption. In the case of tomatoes, spoilage primarily results from microbial activity, enzymatic degradation, and environmental factors such as temperature and humidity [9]. The fruit's high moisture content (approximately 93–95%) and moderate acidity create an ideal environment for the proliferation of spoilage microorganisms, particularly fungi and bacteria [10]. This vulnerability stresses the importance of post-harvest handling, processing, and preservation strategies designed to mitigate microbial contamination and maintain product quality.

Fungi are among the most persistent and destructive agents of spoilage in tomato products, including canned tomatoes [11]. Fungi are eukaryotic microorganisms that thrive in moist, nutrient-rich environments and can grow under a wide range of temperature and pH conditions [12]. In the context of food spoilage, they play dual roles; while some species contribute beneficially to food fermentation and preservation, others are pathogenic, leading to significant post-harvest and processed food losses [13-15]. Common fungal genera implicated in tomato spoilage include *Aspergillus*, *Penicillium*, *Rhizopus*, *Fusarium*, and *Alternaria* [16]. These fungi can degrade tomato tissues by secreting extracellular enzymes such as pectinases, cellulases, and proteases, which break down plant cell walls and result in softening, discoloration, and off-odors [17].

More concerning is the ability of certain fungi, notably *Aspergillus flavus* and *Aspergillus parasiticus*, to produce mycotoxins; toxic secondary metabolites that pose serious health hazards to consumers [18]; mycotoxins such as aflatoxins are carcinogenic, mutagenic, and immunosuppressive [19]. Chronic exposure, even at low levels, has been associated with liver cancer, growth retardation in children, and suppression of immune responses [20, 21]. Thus, fungal contamination in canned or processed tomato products not only compromises aesthetic and organoleptic qualities but also raises significant public health concerns [22]. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) have continually emphasized the need for monitoring and controlling fungal contamination in food products to ensure consumer safety and reduce global food losses [23- 25].

The tomato processing industry often relies on canning as a preservation technique designed to extend shelf life by eliminating or reducing microbial activity. Canning is based on thermal processing, where food is heated to destroy pathogenic microorganisms and sealed in airtight containers to prevent recontamination. While this method has proven effective for most bacterial contaminants, it does not always guarantee complete inhibition of fungal growth, particularly if post-processing contamination occurs due to improper sealing, poor handling, or compromised storage conditions [26]. Spoilage fungi such as *Rhizopus stolonifer* and *Aspergillus niger* can survive under suboptimal sterilization or find entry through small imperfections in packaging, leading to slow but progressive spoilage [15].

The occurrence of fungi in canned tomato products indicates lapses in hygiene, equipment sterilization, or environmental control within the production or distribution chain [27. Food safety professionals emphasize that microbial contaminations are often multifactorial, involving not only the microorganisms themselves but also human behavior, environmental factors, and technological inefficiencies [28]. Inadequate cleaning of processing equipment, use of contaminated raw materials, and improper storage temperatures can all contribute to the persistence of fungal spores. Therefore, understanding the microbial ecology of canned foods is essential for designing effective control strategies.

The implications of fungal contamination in tomatoes extend beyond spoilage to broader socioeconomic and health dimensions. Economically, fungal spoilage contributes to food waste, financial losses for producers and retailers, and increased production costs due to recalls or reprocessing [29]. Socially, it undermines consumer trust and food security, particularly in low- and middle-income countries where access to refrigeration and quality control infrastructure is limited [24]. From a public health standpoint, ingestion of contaminated tomato products may lead to foodborne illnesses, allergic reactions, and chronic exposure to mycotoxins, all of which disproportionately affect vulnerable populations such as children, pregnant women, and immunocompromised individuals. [30]

Despite the numerous reviews and studies on microbial contamination in tomato products, there remains a lack of comparative research focusing specifically on the fungal species associated with different commercial canned tomato brands. To address this gap, the present study undertakes a comparative investigation of fungi isolated and identified from Gino and Sonia canned tomatoes. This research is essential as it aligns with the global goal of reducing food spoilage and promoting food safety, which supports the United Nations Sustainable Development Goals (SDG 2 and SDG 12) on ending hunger and fostering responsible production and consumption. Ensuring the safety of canned tomatoes, the study contributes to the development of a more sustainable and health-conscious food system through reduced waste, enhanced consumer confidence, and improved public health protection. Therefore, the objectives of this study are threefold, to isolate fungi present in Gino and Sonia canned tomatoes, to identify the fungal species isolated, and to compare the degree of fungal contamination between the two brands.

2. MATERIALS AND METHODS

Study Design and Experimental Site

This study was designed as a comparative laboratory investigation aimed at isolating and identifying fungal species present in two commercial brands of canned tomatoes (Gino and Sonia). The experiment was conducted at the Biology Laboratory of the Oyo State College of Agriculture and Technology, Igboora, Oyo State, Nigeria. The laboratory was equipped with standard microbiological facilities and maintained under aseptic conditions to ensure the reliability and reproducibility of results.

Sample Collection

Two brands of commercially available canned tomatoes, Gino and Sonia, were randomly purchased from local retail outlets in Igboora, Oyo State. Each sample was examined for intact packaging and valid expiry dates before use to ensure quality and authenticity. The samples were transported to the laboratory under aseptic conditions and analyzed immediately upon arrival to prevent external contamination.

Materials and Reagents

All materials and reagents used in this study were of analytical grade. Glassware and instruments were sterilized using an autoclave at 121°C for 15 minutes prior to use. Sterile distilled water, inoculating loops, Petri dishes, conical flasks, and test tubes were used throughout the experiment. Potato Dextrose Agar (PDA) was selected as the culture medium due to its efficacy in supporting fungal growth and differentiation.

Preparation of Culture Media

Potato Dextrose Agar (PDA) was prepared following the manufacturer's specifications. The medium was sterilized by autoclaving at 121°C for 15 minutes and allowed to cool to 45–50°C before being poured into sterile Petri dishes under laminar airflow conditions. The PDA plates were left to solidify and stored in an inverted position to prevent condensation before inoculation. The prepared medium served as a selective and nutrient-rich environment for fungal isolation.

Isolation of Fungi

Fungal isolation was carried out using the pour plate technique. Under aseptic conditions, 1 mL of each tomato sample homogenate was introduced into sterile Petri dishes, followed by the addition of molten PDA at approximately 45°C. The plates were gently swirled to ensure uniform distribution of the inoculum and incubated at 37°C for 48 hours under aerobic conditions. After incubation, distinct fungal colonies were observed, sub-cultured on fresh PDA plates, and purified for further identification.

Identification of Fungal Isolates

The isolated fungi were identified based on both macroscopic and microscopic characteristics. Macroscopic identification involved assessing colony morphology, pigmentation, and surface texture. Microscopic identification was performed using the lactophenol cotton blue staining technique. Small portions of the fungal mycelium were mounted on slides, stained, and examined under a compound microscope. Identification was carried out by comparing observed morphological characteristics with standard fungal identification manuals, including Barnett and Hunter [31] and Samson et al. [32].

Data Analysis

The occurrence and frequency of fungal isolates from each tomato brand were recorded and compared. The data were presented descriptively to show variations in fungal contamination between Gino and Sonia canned tomato brands. Observations were interpreted in relation to existing literature on fungal spoilage of processed tomato products.

3. RESULTS

Result presents the morphological characterization and identification of fungi isolated from the two canned tomato brands examined. The findings revealed distinct fungal species in each sample, indicating brand-specific contamination patterns possibly influenced by processing or storage conditions (See Table 1.0). In the Gino canned tomato sample, greenish colonies with defined borders and long unbranched conidiophores were observed. These macroscopic and microscopic features are characteristic of *Aspergillus flavus*, a filamentous fungus widely recognized for its ability to produce aflatoxins; secondary metabolites that are toxic and carcinogenic to humans. The presence of *A. flavus* in the Gino sample suggests possible contamination during processing or post-packaging exposure to favorable environmental conditions such as moisture or inadequate sealing. This finding is consistent with previous studies that have reported *A. flavus* as a common contaminant in processed tomato products and other high-moisture foods due to its thermotolerant spores and ability to thrive under a range of environmental conditions.

In contrast, the Sonia canned tomato sample exhibited white colonies that later turned grey, with broad, non-septate hyphae, which are typical morphological characteristics of *Rhizopus stolonifer*. This fungus, commonly known as black bread mold, is a fast-growing spoilage organism frequently found in fruits, vegetables, and other carbohydrate-rich foods. Its presence indicates potential contamination from raw materials or during post-sterilization handling. Although *R. stolonifer* is not typically associated with mycotoxin production, its enzymatic activity can cause rapid softening, discoloration, and degradation of the product, leading to reduced quality and shelf life.

Table 1.0: Indicate the Morphological Characterization of the Isolated Fungi

Sample	Morphological Characterization	Probable isolate (Fungi)

Gino	Greenish colonies with borders, long unbranched cornidiophores	*Aspergillus flavus*
Sonia	White colonies that turned grey with non-septate hyphae	*Rhizopus stolonifers*

The isolation of these fungi from both brands demonstrates that canned tomato products, despite undergoing thermal processing, remain susceptible to fungal contamination if aseptic techniques and proper storage are not strictly maintained. This outcome reinforces the importance of continuous microbial surveillance in food manufacturing processes. Moreover, the detection of *A. flavus* in particular raises serious public health concerns due to the risk of aflatoxin exposure, which has been linked to liver toxicity and carcinogenesis.

4. DISCUSSIONS

The findings of this study reveal that both Gino's and Sonia's canned tomatoes are vulnerable to fungal contamination, highlighting a critical concern for food safety and quality. The fungi identified; *Rhizopus stolonifer*, *Aspergillus flavus*, and various yeast species, are not only prevalent in agricultural environments but are also known to thrive in conditions that are often present during the processing and storage of canned foods.

Fungal contamination can lead to significant degradation of the tomatoes' quality, affecting their taste, texture, and nutritional value. For instance, *Aspergillus flavus* is particularly concerning due to its ability to produce aflatoxins, toxic compounds that pose serious health risks to consumers. These mycotoxins can lead to foodborne illnesses and have been linked to long-term health issues, including liver damage and cancer [33, 34].

Moreover, the high moisture content inherent in tomatoes creates an ideal environment for fungal growth, making it essential for manufacturers to implement stringent quality control measures throughout the canning process. This includes proper sterilisation techniques, maintaining optimal storage conditions, and regular monitoring for microbial contamination.

The results of this study corroborate previous research that has documented similar fungal species associated with tomato spoilage. Such consistency across studies underscores the need for ongoing surveillance and research into effective preservation strategies to mitigate the risk of spoilage and ensure consumer safety. Understanding the types of fungi that can contaminate canned tomatoes, producers can better tailor their processing methods to address these threats, ultimately enhancing the safety and quality of their products.

5. CONCLUSION AND RECOMMENDATIONS

This comparative study on fungi isolated from Gino and Sonia canned tomatoes has demonstrated that both brands are susceptible to fungal contamination despite undergoing industrial canning processes. The isolation of *Rhizopus stolonifer*, *Aspergillus flavus*, and various yeast species indicates that contamination can occur either during processing, packaging, or storage, and that such microorganisms can persist under conditions thought to be unfavorable for their survival. The presence of *Aspergillus flavus*, a known producer of aflatoxins, further emphasizes the potential public health risks associated with consuming contaminated canned tomato products. The findings underscore the importance of enforcing strict hygienic standards and quality control measures throughout the production and supply chain. Manufacturers should ensure proper sterilization, aseptic sealing, and monitoring of storage conditions to minimize microbial growth. Moreover, the adoption of suitable preservative agents and regular microbiological testing can substantially reduce spoilage and extend product shelf life. From a broader perspective, improving the microbiological safety of processed foods such as canned tomatoes align with global efforts to promote sustainable food systems, reduce waste, and safeguard consumer health in accordance with the United Nations Sustainable Development Goals (SDG 2 and SDG 12). Continuous research, surveillance, and technological innovation are therefore recommended to develop more effective preservation strategies that enhance both food safety and sustainability.

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