

Predisposing Condition of Irish Potato Spoilage by Some Fungal Species

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Abstract: Predisposing condition of Irish potato spoilage by some fungal species were analysed, five different fungi were found to be causative agent of Irish potato spoilage. The result indicated that, Aspergillus niger, Aspergillus flavus, Fusarium oxysporum, Penicillium species, and Alternaria alternata were responsible for storage rot of Irish potato tubers in Maiduguri. Aspergillus niger has the highest frequency of occurrence followed by Aspergillus flavus, Alternaria alternata and Penicillium species, has the least percentage frequency of occurrence. Temperature, intact and abrasion on the potato played a significant role in the potential of the fungi to cause spoilage within short period of exposure., growth were observed in all the fungi except Aspergillus niger at 15°C and might not be unconnected with the low temperature. but at temperatures 30° C, 25° C growth were seen in all the fungal isolates Fusarium oxysporum species showed maximum mycelial growth at the temperature of 30° C, 25° C and the least growth was observed at 15° C respectively.

Keywords: Spoilage, Irish potato, Fungi

INTRODUCTION

Irish potato is a whole food that contains high carbohydrate, protein and vitamins. It also contains minerals such as phosphorus, iron, potassium, and magnesium. It has about 70% water content (Murano, 2003). It is categorized by its large brown lozenge shape. It has green in colour when it is not matured and yellowish brown while matured. It develops underground from the swollen, underground stem of the plant. It grows most excellent in environment where there is cool at nights and warm in the days during tuber formation. Irish potato is eaten fresh particularly in developing countries. For almost 2030 years the Irish potato was limited to the highland tropics and was restrained to use by privileged economic groups. Against this condition potato merchants afforded refrigerated storage methods because the production was exceedingly low. Irish potato is rapid fetching staple food of lots of people and numerous countries. Nigeria, Kenya and India are of particular interest as the potato is rapidly becoming acceptable as a subsistence crop and crop for sale at high cost for luxury market. Potato needs a growing temperature of $15^{\circ}C - 20^{\circ}C$. Base on its nutrient and water contents, it is easily susceptible to microbial attack especially when the skin is physically abraded or damaged due to harvesting or transportation (Donna, 2008).

Postharvest decays of fruits vegetables and tubers cause significant level of postharvest losses. It is estimated that 20-25% of the harvested fruit, vegetable and tubers are decayed by pathogens in postharvest management even in the developed nations (El-Gaouth *et al.*, 2004; Singh and Sharma, 2007). In developing nations, food spoilage are often more severe due to insufficient

storage and transportation services. Synthetic fungicides are employed to control postharvest diseases of fruit vegetable and tubers (El-Gaouth *et al.*, 2004; Singh and Sharma, 2007)

Infestation by fungi, bacteria and viruses are perhaps the most serious courses of postharvest losses of between 25% and 60% (Booth, 1974); Ameinyo and Ataga, (2006) reported *Rhizopus oryxae* and *Aspergillus niger* as being liable for sweet potato rot. Surkova, (1989) reported that *Fusarium oxysporium*, *Fusarium tricloothecoides* and *Fusarium radicicola* is responsible for potato tuber rot. The three species were found to be susceptible to rot with higher relative humidity and temperature. The use of dry and cool storage is therefore significant in reducing the loss. Wheeler (1979) reported that several storage diseases associated with tuber rots caused by *Rhizopus spp*, causes soft rot of fleshy parts which proceed rapidly at lower temperature. The disease which occur in transit and storage often result primarily from the activity of fungi and bacteria. Studies carried out by different workers undoubtedly indicate that the real cause of the spoilage of tubers in shipment or storage is as a result of high temperature and aberration sustained by the tubers during the process of marketing and transport (Ameinyo and Ataga, 2006).

Many factors are responsible for spoilage. These can be divided into intrinsic and extrinsic factors. Intrinsic factors are those that are characteristic of the food itself, extrinsic factors are those that refer to the environment surrounding the food. The need for time/temperature control is primarily determine by the potential for contamination with pathogens, the potential for subsequent growth and toxin production (Mossel *et al.*, 1995).

Microorganisms be it fungi or bacteria need water in an available form to grow in food products. The control of water content in foods is one of the most exploited preservation strategies. Food microbiologists described the water requirement of microorganisms in terms of the water activity (a_w) of the food or environment. Water activity is the ratio of water vapour pressure of the food substrate to the vapour pressure of pure water at the same temperature (Jay, 2000).

Most fresh foods, such as fresh meat, vegetables and fruits, have water activity values that are close to the optimum growth level of most microorganism is (0.97 - 0.99). The water activity can be manipulated in food through the addition of solutes (salt o sugar) (Mossel *et al.*, 1995).

Enhancement in the acidity of foods, by fermentation and adding up of weak acids as well were employed as a preservation method in ancient times. Most foods such as meat, vegetables are to some extent acidic whereas the majority fruits are reasonably acidic. (ICMSF, 1980).

Some foods naturally possess antimicrobial compounds that convey some level of microbiological stability to them, these includes products such as glycosides, and resins, essential oils, tannins, that can be found in certain foods. Specific examples include eugenol in cloves, allicin in garlic, cinnamic aldehyde and eugenol in cinnamon, allyl isothiocyanate in mustard, eugenol and thymol in sage, and carvacrol (isothymol) and thymol in oregano (Jay 2000). Other plant-derived antimicrobial constituents include the phytoalexins and the lectins. Lectins are proteins that can specifically bind to a variety of polysaccharides, including the glycoproteins of cell surfaces (Mossel *et al.*, 1995).

However, despite such naturally occurring products micoroorganism with vast pathogenicity island invade and cause spoilage.

METHODOLOGY

Study Area

Borno State is located in the north-eastern geopolitical zones of Nigeria; it lies in latitude 10⁰N and 13⁰E. It shares international boundaries with the countries like Niger to the north, Chad to the North east and Cameroon to the east. It also shares national boundaries with Adamwater

activitya to the south, Yobe to the west and Gombe to the east. The State has an area of 69,435sq kilometres, which is equivalent to 7.69% of the total land area of the country. According to 2006 Census figure, the State has population of 4,151,193 with population density of approximately 60 inhabitants per square kilometres (National Population Commision, 2006). Maiduguri is located 11.85 latitude and 13.16 longitudes and it is situated at elevation 325 meters above sea level (Aliyu et al, 2014)

Isolation and Identification of Associated Fungi

Fifty five (55) diseased tubers of Irish potato were cut through by means of sterile knife. Slicing was done starting from the healthy portions. Pieces of 5x5mm was diluted with sterile distilled water and plated on already prepared Saboroud dextrose agar (SDA) and incubated in an incubator at room temperature for 24 to 35 hours. (Ibrahim *et al.*, 2014).

Representative colony types were purified by sub culturing on fresh SDA plates. The isolated fungi were identified based on the isolates colonial characteristics on culture plates and microscopic features in slides. A sterile inoculating needle was used to fetch a portion of each mycelia colony and was aseptically placed on a clean microscope slide and teases in a drop of lacto phenol cotton blue and observed under the microscope. The isolates were identified by using coloured atlas initially printed (Ibrahim *et al.*, 2014).

Surface sterilization of fresh potato

The surface of the potato be used were sterilized using 70% ethanol to ensure that only the pure fungal isolate were in contact with the potato

Re - infection of potatoes plant with fungal isolates

The various fungal isolate were reintroduced to the potato under different conditions:

- i. intact potato(carefully selected)
- ii. abraded potato

The sterilised potatoes were intermingled with each of the fungal isolates and culture at 15°C, 25°C and 35°C for 35 hours respectively and were observed for fungal growth.

RESULT AND DICUSSION

 Table 1: Frequency and Percentage for Fungal Species Responsible for Spoilage of Potato in (Gamboru market)

S/No	Fungal specie	Frequency	Percentage %
1	Aspergilus niger	16	29.09
2	Aspergilus flavus	10	18.18
3	Penicillium species	11	20.00
4	Alternaria alternata	12	21.82
5	Fusarium oxysporum	6	10.91
Total		55	100 %



Figure1: Graphical Illustration of Fungal Species Responsible for Spoilage of Potato. (Frequency of occurrences)

S/No	Fungal species	15°C	25°C	35°C
1	Aspergilus niger	-	+	+
2	Aspergilus flavus	+	+	+
3	Penicillium species	+	+	+
4	Alternaria alternata	+	+	+
5	Fusarium oxysporum	+	+	+

Table 2 Fungal Growth on Abraded Potato at Various Temperatures after 35hrs

+ = growth

-= no growth

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S/No	Fungal species	15°C	25°C	35°C
1	Aspergilus niger	-	-	-
2	Aspergilus flavus	-	-	-
3	Penicillium species	-	-	-
4	Alternaria alternata	-	-	-
5	Fusarium oxysporum	-	-	-

Table 3 Fungal Growth on Intact Potato at Various Temperatures after 35hrs

Key: -= no growth

+ = growth

DISCUSSION

Table 1 above showed the results of the isolation of fungi from rotten Irish potato tubers where a total of 5 fungi were recovered from rotten Irish potato tubers. The result indicated that, Aspergillus niger, Aspergilus flavus, Fusarium oxysporum, Penicillium species, and Alternaria alternata were responsible for storage rot of Irish potato tubers in Maiduguri. Aspergillus niger has the highest frequency of occurrence followed by Aspergillus flavus, Alternaria alternata and Penicillium species, has the least percentage frequency of occurrence. This is similar to the findings of (Ibrahim et al., 2014) who identified R. stolonifer, Aspergillus niger, A. flavus, F. oxysporum, Penicillium species, M. racemosus and Alternaria alternata species were responsible for postharvest rot of Irish potato tubers. The results of this study are in agreement with the findings of other researchers (Muhammad et al., 2004; Dimka and Onuegbe, 2010) that fungi constitute a menace in storage rot of many agricultural commodities. It was observed that A. niger is the most frequently isolated fungus from rotten Irish potato tubers in Maiduguri. But (Salami and Popoola, 2007) discovered that F. oxysporum is the most frequently isolated fungus from rotted irish potato tubers in south-western Nigeria. It has been reported by (Amienyo and Ataga, 2007) that R. stolonifer is the most frequently isolated fungus from rotten sweet potato tubers. This could be attributed to its ability to produce numerous spores (Chiejina, 2006). The variations of the fungal isolates to cause different level of decay may be due to differences in their ability to utilize tuber components as food for growth (Nwachukwu, 2006).

Similarly, when the isolated fungi were exposed to abraded, growth were observed in all the fungi except *Aspergilus niger* at 15°C and might not be unconnected with the low temperature. According to Imran et al, (2011) Fusarium oxysporum species showed that maximum mycelial growth was observed at the temperature of 30° C, 25° C and the least growth was observed at 15° C respectively.

However, no growth were observed when the same fungi were exposed to intact fungi at various temperatures, this may be due to shorter period of exposure, inability to penetrate the outer covering of the potatoes.

CONCLUTION

Based on the outcome of this research in can be concluded that *Aspergillus niger* is the principal caused of Irish potato spoilage in Maiduguri followed by the other isolated fungi. This study has shown that many fungi have been found to cause storage rot of Irish potato in Maiduguri. And that temperature and abrasion contribute to the spoilage.

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