Scientific Papers. Series B, Horticulture. Vol. LVIII, 2014
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

# BIOCHEMICAL CHANGES IN GARDEN EGG *(Solanum melongena* L.*)* FRUITS CAUSED BY FUNGI

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***Abstract***

*Garden egg (Solanum melongena L.) fruits are major sources of food in Nigeria, especially during weddings and occasions. This major food crop is constantly being affected by fungi, causing deterioration of the fruit. Biochemical analyses were carried out, according to the methods of the Association of Official Analytical Chemists, to determine the changes that occur in two locally identified varieties of garden egg (Solanum melongena L.) fruits inoculated with Alternaria alternata, Aspergillus flavus, Mucor hiemalis and Rhizopus stolonifer. The two varieties are 'Yallon bello' (YB) and 'Chi da Masoyi' (CM). Significant increases were observed in moisture, protein, crude fat, fibre and ash contents of the two varieties inoculated with the fungi, as compared with uninoculated fruits. In the YB variety, A. alternata, A. flavus, M. hiemalis and R. stolonifer increased the moisture content 2.4%, 4.2%, 7.2%, 6.0%; protein content 2.0%, 2.0%, 3.2%, 2.2%; crude fat content 4.5%, 5.5%, 4.5%, 5.5%; fibre content 2.5%, 2.0%, 2.0%, 2.0%; and ash content 20.0%, 20.0%, 24.3%, 22.9%, respectively. The four fungi caused a significant reduction of 8.0%, 9.4%, 14.0%, 14.0% in carbohydrate, and 1.2%, 1.6%, 1.3%, 1.6% in vitamin contents, respectively. Similarly, in the CM variety, A. alternata, A. flavus, M. hiemalis and R. stolonifer increased the moisture content 3.3%, 3.8%, 4.8%, 3.8%; protein content 4.8%, 3.0%, 4.8%, 4.1%; crude fat content 6.9%, 5.4%, 8.5%, 10.0%; fibre content 3.4%, 2.5%, 4.1%, 3.6%; and ash content 10.4%, 11.6%, 14.0%, 10.5%, respectively. The four fungi caused a significant decrease of 7.0%, 6.2%, 8.5%, 7.7% in carbohydrate, and 1.5%, 1.1%, 1.9%, 2.1% in vitamin contents, respectively. The results of this research showed that fungi are associated with the deterioration of garden egg fruits and alters the nutritional components of the fruit.*

***Key words:*** *biochemical changes, fungi, garden egg*

## INTRODUCTION

Garden egg (*Solanun melongena* L.) is grown in almost all parts of the world, including Africa, Europe, Asia, South and North America (Aguiar et al., 1998). The plant produces small to moderately white fruits, resembling the chicken egg, hence the name "garden egg" (Granberry, 1990). An official report by the United States Department of Agriculture (USDA, 2005) explains that the fruit is nutritious and contain C vitamin and potassium. It also contain 24 Kcal of energy, 5.7g of carbohydrate, 3.4g of dietary fibre, 1.01g of protein, 4% of vitamin C and 5% of potassium. Fungi have been identified to be associated with garden egg fruit rot. Anthracnose, a common fungal rot caused by the fungus *Colletotrichum coccodes,* was reported by Zitter (1989) as a major fungus associated with garden egg fruit rot. The fungi *A. alternata*, *A. flavus, M. hiemalis* and *R. stolonifer* were identified as the major fungi affecting garden egg (Kuc'mierz and Sumera, 2009). Therefore, it is important to note that post harvest fungal fruit rot is inevitable. The fungi increase the fruits' vulnerability to other pathogens, leading to certain biochemical changes on the fruits (Kuc'mierz and Sumera, 2009). There is no official report documented on the effects of fungi on the nutritional composition of garden egg fruits in Northern Nigeria, and Plateau State in particular. The present study was therefore undertaken to investigate the roles of the fungi (*A. alternata*, *A. flavus, M. hiemalis and R. stolonifer*) on the biochemical changes of the fruits.

## MATERIALS AND METHODS

The two garden egg fruit varieties used in this study were obtained in markets within the Jos – Bukuru Nigerian metropolis in Plateau State. The fungi were isolated from naturally infected fruits on Malt Extract Agar (MEA) medium, using the procedure of Clement and Voros (1974).

The fungi were identified under a stereo binocular microscope (6 – 50x) based on their habit characteristics. Slides were made to confirm identification following descriptions by Ellis and Ellis (1987).

Pure, single spore cultures of each fungus were obtained by growing them on MEA. The cultures were grown for 5 – 7 days in complete darkness at 21 ± 2ºC before use as inoculum.

Healthy samples of the two varieties of the garden egg fruits were thoroughly cleaned, and surface sterilized with cotton wool, soaked in 1% sodium hypochlorite solution, to remove sand and other contaminants before weighing.

After weighing, a sterilized cork borer (size 3) was used to bore holes in the fruits in Petri dishes. Another cork borer (size 3) was used to bore out a culture disc from 7-day old cultures (inoculum) grown on MEA medium.

Each fungal culture was picked with a different sterile cork borer to avoid contamination. Some of the healthy fruits were left without holes to serve as control. The inoculum discs, of each fungus isolated, were inoculated into the holes made on the fruits. Vaseline cream was used to seal the surface of the fruits, while cotton wool was used to cover the areas where Vaseline cream was applied. This was meant to avoid external contaminants (Cherry and Beuchat, 1975).

The fruits that served as control received the same treatment, but they were not inoculated with any fungus. All the fruits (fungus–inoculated and control) were wrapped in sterile polythene bags containing moistened cotton with distilled water and incubated at 25 ± 2ºC in complete darkness for 7 – 14 days.

After 14 days, fungus–inoculated fruits and control samples were collected and weighed. After weighing, they were sliced differently into small sizes for uniform drying.

The samples were oven–dried at 100ºC for about 24 hours. After drying, they were milled into powdery form. Ten grams (10g) of each sample was used for the biochemical analyses of the various nutrient components (moisture, carbohydrate, protein, crude fat, fibre, ash and vitamins) in both fungus inoculated and uninoculated fruits of the two varieties at various incubation periods (7, 14 days).

The analyses were done following the procedures recommended by the Association of Official Analytical Chemists (AOAC, 1980).

The results, for each food component, were subjected to statistical analyses using the Analysis of Variance (ANOVA).

## RESULTS AND DISCUSSIONS

The results of the biochemical analyses for the fungus – inoculated garden egg fruits and uninoculated controls in the two varieties incubated for 7–14 day intervals are presented in Tables 1 and 2, for the YB and CM varieties, respectively. The fungi caused appreciable changes in the food components of the two varieties.

Moisture content, protein content, crude fat content, fibre content and ash content showed significant increases (P = 0.05) in the fruits inoculated with *A. alternata*, *A. flavus,* M. *hiemalis and R. stolonifer,* as compared to the uninoculated fruits (Tables 1 and 2). The carbohydrate and vitamin contents decreased significantly (P = 0.05), as compared to the uninoculated controls.

In the YB variety, fruits inoculated with *M. hiemalis* recorded the highest increase in moisture and ash contents (7.2%, 24.3%), while those inoculated with *A. flavus* and *R. stolonifer* recorded the highest increased in crude fat content (5.5%). Similarly, fruits inoculated with *M. hiemalis* recorded the highest increase in protein content (3.2%).

The lowest decrease in carbohydrate and vitamin contents were recorded in fruits inoculated with *A. alternata* (8.0%, 1.2%).

In the CM variety, fruits inoculated with *M. hiemalis* recorded the highest increase in moisture and ash contents (4.8%, 14.0%). Also, fruits inoculated with *M. hiemalis* recorded the highest decrease in carbohydrate and vitamin contents (8.5%, 1.9%).

Table 1. Changes in the levels of nutrients of the YM variety of garden egg fruits inoculated with fungi and incubated at 25± 2ºC for 7-14 days

| Nutritional composition (%W/W) | Control (uninoculated) | | *A. flavus* | | *A. alternata* | | *M. hiemalis* | | *R. stolonifer* | | **L.S.D** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | 14 | *7* | *14* | *7* | *14* | *7* | *14* | *7* | *14* | |
| Moisture content | 8.3 | 8.3 | 8.6 | 8.7 | 8.4 | 8.6 | 8.8 | 9.0 | 8.7 | 8.9 | **0.9** |
| Carbohydrate content | 6.9 | 6.9 | 6.3 | 6.2 | 6.5 | 6.2 | 6.0 | 5.8 | 6.1 | 5.8 | **0.7** |
| Protein Content | 20.3 | 20.3 | 20.6 | 20.8 | 20.6 | 20.8 | 20.8 | 21.1 | 20.7 | 20.8 | **1.2** |
| Crude fat content | 5.5 | 5.5 | 5.7 | 5.9 | 5.6 | 5.9 | 5.6 | 5.9 | 5.7 | 5.9 | **0.7** |
| Fiber content | 20.3 | 20.3 | 20.6 | 20.8 | 20.7 | 20.9 | 20.5 | 20.9 | 20.6 | 20.9 | **1.2** |
| Ash content | 3.5 | 3.5 | 4.1 | 4.3 | 4.1 | 4.3 | 4.2 | 4.5 | 4.2 | 4.4 | **0.7** |
| Vitamin content | 40.8 | 40.3 | 40.3 | 40.0 | 40.5 | 40.1 | 40.4 | 40.1 | 40.3 | 40.0 | **1.8** |

*L.S.D. - Least significant difference for comparison of treatment means

Table 2. Changes in the levels of nutrients of the CM variety of garden egg fruits inoculated with fungi and incubated at 25± 2ºC for 7-14 days

| Nutritional composition (%W/W) | Control (uninoculated) | | *A. flavus* | | *A. alternata* | | *M. hiemalis* | | *R. stolonifer* | | **L.S.D** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | 14 | *7* | *14* | *7* | *14* | *7* | *14* | *7* | *14* | |
| Moisture content | 10.5 | 10.5 | 10.8 | 11.0 | 10.8 | 10.9 | 10.8 | 11.2 | 10.8 | 11.0 | **0.7** |
| Carbohydrate content | 6.5 | 6.5 | 6.2 | 6.0 | 6.2 | 5.9 | 6.1 | 5.8 | 6.1 | 5.9 | **0.8** |
| Protein Content | 22.0 | 22.0 | 22.6 | 22.7 | 23.0 | 23.1 | 22.9 | 23.2 | 22.8 | 23.0 | **1.3** |
| Crude fat content | 6.5 | 6.5 | 6.8 | 6.9 | 6.9 | 7.0 | 6.9 | 7.2 | 7.0 | 7.3 | **0.9** |
| Fiber content | 22.1 | 22.1 | 22.5 | 22.8 | 22.8 | 22.9 | 22.9 | 23.1 | 22.8 | 23.0 | **1.4** |
| Ash content | 4.3 | 4.3 | 4.7 | 4.9 | 4.7 | 4.8 | 4.8 | 5.0 | 4.6 | 4.9 | **0.7** |
| Vitamin content | 41.2 | 41.2 | 40.9 | 40.6 | 40.8 | 40.4 | 40.6 | 40.2 | 40.6 | 40.1 | **1.8** |

*L.S.D. - Least significant difference for comparison of treatment means

Inoculation of garden egg fruits with pure cultures of *A. alternata, A. flavus, M. hiemalis* and *R. stolonifer* and incubated for 7 – 14 days at 25 ± 2ºC resulted in various changes in garden egg fruits' nutrients.

These fungi were identified by Kuc'mierz and Sumera (2009) as the major fungi affecting garden egg seeds.

Increases recorded in the moisture content were probably due to the fungi using some of the components of the garden egg fruits as nutrient, and as a result, producing water in the process. This is in conformity with the results obtained by Ataga and Akueshi (1986a) on sunflower seeds. The inoculated fungi also lead to an increase in crude fat content in the two varieties of the garden egg fruits.

Ward and Diener (1961) obtained similar results on groundnut seeds. They stated that such an increase was due to a decrease in total oil, due to its hydrolysis.

Increase in protein content also conforms to the findings of Ataga and Akueshi (1986b) on sunflower seeds. This may be due to proteinaceous mycelia from the isolated fungi. A decrease in carbohydrate conforms to the findings of Umechuruba *et al*. (1992) on groundnut seeds. This could be due to the mobilization and utilization of storage polysaccharides by fungi. Increase in ash and fibre contents could be due to the presence of certain mineral elements such as potassium and phosphorus in mycelia of fungi. This was also observed by Ataga and Umechuruba (1998) on the African yam bean seeds.

A decrease in vitamin content could be due to the increase in moisture content, causing the vitamin to dissolve in it, since it is a water soluble vitamin.

## CONCLUSIONS

The result of this study shows that the fungi caused deterioration of garden egg fruits and alters the nutritional values of the fruits.

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