Nutritional Composition of African Salad and Their Fungal Pathogens

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Abstract
African salad is a recipe native to Nigeria and cherished mostly by the Igbos. Studies on the nutritional composition of African salad and its associated fungal pathogens were carried out in the Department of Plant Science and Biotechnology and the Food Science and Technology Laboratory respectively in the Rivers State University. The proximate composition of the African salad revealed the presence of moisture, ash, fibre, lipid, carbohydrate and protein, although a general reduction in the parameters analyzed for the fresh samples were observed compared to the spoilt. However, increased values were only recorded for fibre and carbohydrate for the fresh samples. The mineral content found was iron, phosphorus, potassium, sodium and magnesium; every other parameter reduced in the spoilt samples with an exception in magnesium which recorded a value slightly higher than that of its equivalent in the fresh samples. Five fungal organisms were isolated viz: Cryptococcus neoformans, Sclerotium rolfsii, Aspergillus niger, Aspergillus flavus and Fusarium oxysporium. The highest percentage incidence was observed for C. neoformans (50%) while 5% was the least recorded for F. oxysporium.

Key word: *African salad, Nutritional composition and fungal pathogens*

Introduction

African salad is an exotic delicacy and a special salad recipe native to Nigeria and it is popularly called Abacha, Abacha Ncha, Abacha and Ugba by the Igbo tribe of Nigeria. It is usually made up of abacha and ugba with other ingredients and spices. The name African salad is thought to have originated from the Igbo's ideology that salad contains lots of vegetables that are raw and fresh and contains some other ingredients eaten without further cooking, it is therefore a salad of African origin (Maky, 2013). African salad is known to be rich in protein, carbohydrate, vitamins, and minerals. It is widely accessed for its composition of food ingredients. It can be consumed on its own or with other snacks like palm kernel, coconut and groundnut. African salad is usually eaten as an in-between meal, although it can be as filling as any other main course meal or as a side dish to the various Nigerian rice recipes. During traditional festivals, African salad is also regarded as a special delicacy. The sole source of abacha is cassava *(Manihot esculenta* Crantz) and it is regarded as a basic staple food important for the livelihood of up to 500 million farmers and countless processors and traders around the world (Plucknett *et al*., 2000). In Nigeria, the cassava plant is cherished by the easterners (Ibos) and its products a lot. Its tubers are used to prepare various delicacies such as Foofoo, Abacha or African salad, Abacha Nkpo, or Abacha mmiri (Oguwike *et al*., 2014). Ugba (*Pentaclethra macrophylla*), is a product derived from oil bean seeds through alkaline fermentation and popular among the Ibos as well as other ethnic groups in southern Nigeria. It is an important product rich in protein, however plays a social, economic and cultural role in the eastern settlement of

Nigeria. The product serves both as a food flavoring agent and delicacy (Steinkraus, 1983). The ingredients required to prepare African salad differ according to one's available income and taste; and its preparation demands great deal of efforts. The key to a well prepared African salad is ensuring that all the necessary ingredients are well incorporated (Maky, 2013). The ingredients include palm oil, potash, onions, nutmeg, crayfish, salt, pepper, maggi, ogiri (*Ricinus communis*), Ugba (*Pentaclethra macrophylla*), Uziza leaves (*Piper guineense*), garden egg, Utazi leaves (*Gongronema latifolium*), Ukazi leaves (*Gnetum africana*), kpomo, meat and fish (Oranusi *et al*., 2013). The above ingredients are thoroughly mixed with abacha during cooking and preferably served with a cold drink viz: Palm wine, beer or wine (Osewa, 2013).

The unhygienic practices in the production of African salad through its method of processing and the processing environment have contributed to the microbial loads of the product as several microorganisms have been reported to cause contamination and spoilage. Organisms like *Staphylococcus aureus, Bacillus cereus, Enterococci, E. coli*, and fungi such as *Mucor spp, Rhizopus spp, Penicillium and Aspergillus spp* have been isolated and implicated by early researchers (Eni *et al*., 2010; Oranusi *et al*., 2013).

Materials and Methods

Sample Collection

Samples of ready to eat African salad were bought from Mile 3 market Diobu Port Harcourt and brought to the Department of Plant Science and Biotechnology and sent to the Plant Pathology Laboratory where it was observed for spoilage.

Mycological studies

Preparation of mycological medium

Sterilization of conical flask, slides, Petri dishes and all the equipment needed for the experiment was carried out in the laboratory. The glass wares were sterilized in the oven at 120^{o}C for an hour after washing with soap, while other equipment were surface sterilized with 70% ethanol to reduce microbial contamination (Agrios, 2005). Inoculating loops and scalpels were sterilized by dipping for 20 seconds in 70% ethanol and heated to red hot. The mycological medium used was Sabouraud Dextrose Agar prepared in a conical flask using the standard method. The mouth of the flask was plugged with non-absorbent cotton wool and wrapped with aluminum foil. The conical flask containing the mycological medium was autoclaved at 121^{o} C and pressure of 1.1kg cm-3 for 15 minutes. The molten agar was allowed to cool to about 40 ^{o} C and dispensed into Petri dishes at 15mls per plate and allowed to further cool and solidify.

Isolation of fungi from African Salad

One gram of African salad sample showing visible signs of spoilage by Moulds was inoculated onto Sabouraud Dextrose Agar in Petri dishes onto which ampicillin was added to hinder the growth of bacteria in triplicate. The inoculated plates were incubated for 5 days at ambient temperature of 25^{o} C ± 3^{o} C (Baudoni, 1988, Chuku, 2009, Samson *et al*, 1981). The entire set up was observed for 7 days to ensure full grown organisms. Pure culture of isolates was obtained after a series of isolations**.**

Identification of fungal organisms from African Salad

Microscopic examination of fungal isolates was carried out by the needle mount method (Cheesebrough, 2000). The fungal spores were properly teased apart to ensure proper visibility. The well spread spores were stained with cotton blue in lacto phenol and examined

microscopically using both the low and high power objective. The fungi were identified based on their spore and colonial morphology, mycelia structure and other associated structures using the keys of (Samson *et al*, 1981 and Olds, 1983).

Pathogenicity studies

Pathogenicity studies was carried out on African salad to check if the fungi isolated from African salad were capable of causing spoilage in the fresh samples. The methods of (Agrios, 2005, and Trigiano, 2004) were basically followed. The fungal isolates were introduced into African salad and observed for seven days. The set up was monitored regularly for growth.

Determination of nutrient components of African Salad

The samples of African salad were sent to the Food Science and Technology Laboratory for the determination of nutrient composition. The methods of AOAC (2005) were used for the analysis.

Results and Discussion

Table 1: Proximate composition of fresh and spoilt African salad

Parameters	**Percentage Composition (%)**	
	Fresh	Spoilt
Moisture	85.30	90.15
Ash	5.20	5.55
Lipid	36.35	37.65
Fibre	2.50	2.10
Carbohydrate	22.55	18.45
Protein	25.65	27.92

Table 2: Mineral composition of fresh and spoilt African salad

Parameters	**Percentage Composition (%)**	
	Fresh	Spoilt
Calcium	1.26	1.15
Iron	0.52	0.40
Magnesium	1.35	1.40
Sodium	5.80	5.00
Potassium	0.75	0.70
Phosphorus	0.63	0.57

Table 3: Fungal isolates and percentage incidence

Fungal isolates	**Percentage incidence (%)**
Cryptococcus neoformans	50
Sclerotium rolfsii	30
Aspergillus niger	30
Aspergillus flavus	10
Fusarium oxysporium	5

The result for the proximate composition of African salad is presented in Table 1. Moisture value of 85.30 was recorded for fresh African salad samples with a higher value of 90.15 recorded for the spoilt samples. A lower value of ash (5.20) was observed for the fresh samples compared to 5.55 recorded for the spoilt. The values of lipid recorded were 36.35 and 37.65 for the fresh and spoilt samples respectively. The highest value for fibre (2.50) was

recorded for the fresh samples while a lower value of 2.10 was observed for the spoilt samples. Carbohydrate value of (22.55) for the fresh samples was higher when compared to 18.45 recorded for the spoilt samples. This was followed by an increased value for protein (27.92) in the spoilt samples and a reduced value of 25.65 for the fresh samples. The above result implicated a general reduction in the parameters analyzed for the fresh samples compared to the spoilt or contaminated samples. However, increased values were recorded for fibre and carbohydrate in the fresh samples. The increased values recorded for the spoilt samples is in line with early reports because spoilage which is similar to fermentation led to nutrient increase in most fermented foods like ugba a component of African salad (Nurudeen *et al*., 2016). Notwithstanding, the proximate result for the fresh samples is line with the report of Oranusi *et al.*, (2013).

Table 2 showed that calcium, iron, magnesium, sodium, potassium and phosphorus recorded 1.26, 0.52, 1.35, 5.80, 0.75 and 0.63 values respectively for the fresh samples. Nevertheless, the following values (1.15, 0.40, 1.40, 5.00, 0.70 and 0.57) were recorded for calcium, iron, magnesium, sodium, potassium and phosphorus respectively for the spoilt samples. A general overview shows that every other parameter reduced in the spoilt samples except for magnesium which recorded a value slightly higher than that of its equivalent in the fresh samples.

Five fungal organisms were isolated in this study from the spoilt African salad in Table 3. and include *Cryptococcus neoformans, Sclerotium rolfsii, Aspergillus niger, Aspergillus flavus and Fusarium oxysporium.* The highest percentage incidence was observed for *C. neoformans* (50%) and this was followed by 30%, 30% and 10% for *S. rolfsii, A. niger* and *A. flavus* respectively, while the least (5%) was observed for *F. oxysporium.* The isolated organisms were subjected to pathogenicity test and were found to cause spoilage in the fresh samples of African salad. The above isolated organisms are the same as those isolated in early works. *Fusarium spp, Aspergillus spp, Candida spp, Rhizopus spp* and *Penicillium spp* were also implicated to cause contamination and spoilage in African salad (Oranusi *et al.*, 2013). However, organisms such as *Aspergillus spp, Rhizopus spp, Fusarium spp* and *Sclerotium spp* were also reported by early research to be associated with ugba a component of African salad (Chuku, 2012).

Conclusion

African salad though cherished by so many because of its nutritional balance is still affected by the unhygienic method of preparation that eventually leads to contamination and spoilage of the delicacy by microorganisms. However adoption of hygienic mode of preparation in a clean and sterile environment will go a long way to reduce the occurrence of these spoilage organisms.

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