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Evaluation of the Nutritional Quality and Post Harvest Rot of Sweet and Irish Potato.

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Abstract:

The study was carried out with the aim of comparing the nutrient quality and post-harvest rot of sweet and Irish potatoes. Fourteen tubers of sweet and Irish potatoes were purchased from mile 3 market in Portharcourt. Nutrient and antinutrient analysis were carried out in Rivers State University. Result for proximate composition revealed that Irish potatoes had high values for moisture (70.57 0±.06%) and lipid (0.740±0.02%) while sweet potatoes had high values for ash (2.330±06%), Fibre (1.33± 0.01%), carbohydrate (34.390±0.02%) and protein (6.44±0.06%) respectively. Mineral composition result showed that sweet potatoes had higher values for calcium (25.83±0.), iron (1.270±0.06), magnesium (0.94±0.01), phosphorus (27.67 ±0.58) and potassium (506.67± 1.1629mg/100g). Antinutrient compositions showed no significant ($p<0.05$) difference in glycosine, oxalate, carotenoid , polyphenols and lignant respectively. Mycological studies revealed that Candida sp., Penicilium sp. and Aspergillus niger to be present in Irish potato while sweet potato recorded Candida sp only. Conclusively, this research revealed that sweet potato nutrient quality was higher than Irish while Irish antinutrient composition were higher than sweet potato and they are prone to fungal contaminations. Proper care should be taken during and after harvest to reduce fungal contaminations.

Keywords: Nutrient quality, post harvest rot, sweet and Irish potatoes.

INTRODUCTION

The sweet potato (Ipomoea batatas (L) is a dicotyledonous perennial plant belonging to the family convolvulaceae (Suraji, Rnaweara, Anil and Arthur, 2013; Solomon, Wassu and Beneberu, 2015). Both the storage roots and the leaves of sweet potato are edible. It is the seventh most important food crop after wheat, rice maize, potato, barley and cassava (CIP, 2000;Ukom, Ojimelukwe and Alamu, 2011; Suraji *et al*., 2013) being cultivated in more than 100 countries (Faostat, 2012; Eleaza and Ironua, 2013 and Rose and Vasanthalsaalam, 2011) with world's average productivity of 15 ton/ha. Global productivity of sweet potatoes estimated to be over 105 million metric tons annually (FAO, 2008). Sweet potato is mainly grown in the tropical and sub-tropical regions where the bulk of the crop is cultivated and consumed (Eleazu and Ironua, 2013; Ellong, Billard and Adenet, 2014). Sweet potato has the advantage of high yield, high resistant to drought and wide adaptability to various climates and farming system (*Lou*, Shimada and Rarkris, 2006; Namutebi, Hill, Farhat and Mitchell, 2013, Hua, Haixin, Hongtao and Yunchao, 2015).

Irish potato has been reported to be a major efficient tuber crop in terms of tuber yield and days of maturity (Sanusi and Babatunde, 2017), Nigeria is the fourth largest Irish potato producer in sub-Saharan Africa and seventh largest producer in Africa with an output of 1,284,370 metric tonnes and yield per hectare of 37,201 hg/ha (3,720.1 kg/ha (FAOSTAT 2019). Domestic consumption of both fresh and processed Irish potato stands 4.63kg/capita (FAOSTAT, 2015). The crop is widely cultivated in commercial quantities in Plateau state and some part of the country (Ojo, 2013), although it is an under exploited food crop with a huge unrealized potentials to improve food security, income and human nutrition (Schulte-Geldermann, 2013).

Nutritional and Phytochemical analysis of sweet and Irish potatoes is gradually becoming very important as the potentials in the food industry are being unravelled around the world. Many studies have determined the nutritional qualities of potato cultivars which were planted in different areas and indicated significant nutrients among different potato cultivars which might be related to soil, climate, cultivation techniques etc (Motallebiferd, Najafi, Oustan, Nyshabouri and Valizade, 2013; Ngobese, Workneh, Alimi and Tesfay, 2017. The study is aimed at evaluating the nutritional (proximate, mineral and vitamins), antinutritional quality and post harvest rot of sweet and Irish potato.

Materials and methods.

Collection of tubers

Fourteen potato tubers each of sweet and Irish potatoes were purchased from mile three market in Portharcourt, Rivers State and were used for this study. Five tubers each of sweet and Irish potatoes were selected, washed cut into slices with 5mm and frees- dried, after that , the dried potato slice were grounded , sieved through 100mesh sieve and then placed at -20^{0}C until analysis. The other two tubers each of sweet and Irish potatoes were used for rot observation and comparism.

Determination of nutrient and anti-nutrient composition of the cocoyam varieties

The treated tuber sample of the sweet and Irish potatoes was sent to the Food Science and Technology Laboratory

for the determination of nutrient and anti-nutrient composition. The methods of AOAC (2000 and 2005) were used for the analysis.

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 (Chuku, 2009). 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 aluminium 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 sweet and Irish potatoes

The direct plating method of Mehrotra and Aggarwal, (2003) was adopted where 0.5cm portion of diseased tubers were cut and dipped in 70% alcohol for 30 seconds and rainsed in distilled water before directly inoculated into Sabouraud Dextrose Agar in Petri dishes containing ampicillin to hinder the growth of bacteria and this was done in triplicate. The inoculated plates were incubated for 5 days at ambient temperature of 25^{o} C ± 3^{o} C (Chuku, 2009). The entire set up was observed for 7 days to ensure full grown organisms. Pure cultures of isolates were obtained after a series of isolations**.**

Identification of fungal organisms from potato tubers

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 Barnett and Hunter, (1998).

Determination of percentage incidence

The percentage incidence of fungal occurrence was determined by the formula stated below (Chuku, Agbagwa and Worlu, 2019):

$$\frac{X}{Y} \times \frac{100}{1} = \%\ \text{incidence}$$

Where:

X= total number of each organism in a variety

Y= total number of all identified organism in a variety.

Statistical Analysis of Data

Data obtained from this study were expressed as mean ± SEM. Analysis of group data was done by one-way analysis of the variance (ANOVA) followed by Duncan test for the establishment of significances. Statistical significance was set at ($P<0.05$).

Results and discussion

Table 1: Proximate Composition of sweet and Irish Potatoes (%)

Parameters	Sweet potato	Irish potato
Moisture	54.67± 0.58^{b}	70.57± 0.06^{a}
Ash	2.33± 0.06^{a}	1.43± 0.06^{b}
Lipid	0.05± 0.00^{b}	0.74± 0.02^{a}
Fibre	1.33 ±0.01^{a}	1.23 ±0.06^{a}
Carbohydrate	34.39± 0.02^{a}	20.33 ±0.01^{b}
Protein	6.44± 0.06^{a}	5.73± 0.01^{b}

Means that do not share a letter are significantly different

Table 2: Mineral Composition of sweet and Irish Potatoes (mg/100g)

Parameters	Sweet potato	Irish potato
Calcium	25.83±0.29[a]	15.27±0.06[b]
Iron	1.27±0.06[a]	0.77±0.06[b]
Magnesium	0.94±0.01[a]	0.33±0.06[b]
Phosphorus	27.67±0.58[a]	26.07±0.06[b]
Potassium	506.67±1.16[a]	169.43±125.69[b]
Sodium	54.00± 0.00[b]	99.97±0.06[a]

Means that do not share a letter are significantly different

Table 3: Vitamin Composition of sweet and Irish Potatoes (mg/100g)

Parameters	Sweet potato	Irish potato
Vitamin C	0.00± 0.00[a]	0.00± 0.00[a]
Vitamin A	0.10± 0.00[a]	0.20± 0.00[a]
Thiamine	115.00± 0.00[b]	124.67± 0.58[a]
Chlorophyll	0.00± 0.00[a]	0.00± 0.00[a]

Means that do not share a letter are significantly different

Table 4: Anti-nutritional Composition of sweet and Irish Potatoes (%)

Parameters	Sweet potato	Irish potato
Glycoside	0.00± 0.00[a]	0.00 ± 0.00[a]
Oxalate	0.02± 0.00[a]	0.02±0.00[a]
Saponins	0.42± 0.01[b]	14.97± 25.14[a]
Tannins	0.02± 0.01[b]	0.15± 0.00[a]

Carotenoid	2.15± 0.01[b]	2.20± 0.00[a]
Polyphenol	9.20± 0.00	9.40± 0.00
Flavonoid	22.50± 0.00[b]	25.27± 0.06[a]
Lignin	7.27± 0.06[a]	7.53± 0.06[a]

Means that do not share a letter are significantly different

Table 5: Fungal Isolates and Their Percentage Incidence

Fungal Isolates	Irish potato	sweet potato
Candida sp.	60	100
Penicillium sp.	10	-
Aspergillus niger	10	-

Sweet and Irish potatoes are important plants that play important roles in ensuring food availability and security. They are rich in starch and have been also reported to also contain minerals and phytochemicals. Result of the proximate composition revealed that Irish and sweet potatoes recorded 70.57±0.06 and 54.67±0.58% for moisture. The high moisture content value recorded in this study could be attributed to inherent differences the varieties. Motalebifard *et al*., (2013) indicated that the deficit of soil moisture resulted in a significant increase in the dry matter percentage of Iran cultivar compared with potatoes which were planted in the soil with well moisture. Cruz, Cruz-Tirado, Delgado, Guzman, Castro, Rojas, and Linares (2018) reported that low moisture content is desired in potato tubers because water content is inversely proportional to the dry matter content and low moisture content linked to high dry matter content is associated with better crispiness and texture of fried product, less frying time eliminates moisture from crisps and fries, less oil absorption during frying, lower risk of soggy products and discoloration during cooking, and higher productivity and profitability. In tandem with moisture content value recorded in this study, Jin, Kim, Kim, Hwang and Choi (2016) reported higher values of 81.10 – 83.74% for moisture content in their study. Total ash content value reported in this study differ significantly among sweet and Irish potatoes but the range of the values of 2.33±o.06 for sweet potato and 1.43±0.06 for Irish potato does not agree with the findings of Jin *et al*., (2016) who reported total ash content in the range of 0.87 - 1.04g/100g in four Korean potato varieties and Sato, Koizumi and Nakazawa (2017) in Japanese varieties respectively. Lipid values of 0.74±0.02 for Irish potato and 0.50±0.00 in this study were however, slightly higher than the range of 0.03 and 0.06g/100g reported by Sato *et al*., (2017) in four Japanese potato varieties. Although the low fat content in potatoes might not have any substantial nutritional effect as it is important in enhancing the sensory attributes of cooked tubers and promoting cellular integrity and resistance to bruising in tubers (Kalita and Jayanty, 2017). Crude fibre values of Irish and sweet potatoes (1.23±0.06 and 1.33±0.01%) reported in this study was higher than those reported by Garcia, do Carmo, de Padua and Leonel (2015) who reported values of 0.61 -0.66mg/100g. Generally, the level of fibres in potatoes is low compared to other vegetables and root crops but interestingly, processed potatoes such as French fries and potato flakes have been found to have a higher concentration of crude fibre (Tsikrik, O' Brien and Rai, 2019). The value for carbohydrate content differ among sweet and Irish potatoes and this difference could be attributed to genotypic differences among the varieties and these values of 20.33±0.01 and 34.39±0.02% for Irish and sweet potatoes compare favourably with the findings of Tsikrik *et al*., (2019) and Jin *et al*., (2016) who reported a range of 16.04 -23.06 and 15.14 -16.07g/100g respectively. According to Beals, (2018), carbohydrate is the principal macronutrient in potato with starch being predominant. Starch content influences the quality of processed potato products and has been reported affect crisps texture whereby higher starch levels yield greater crispiness of the potato chip slices and tubers with high carbohydrate content would thus be suitable for processing of crispy potato chips (Abbasi, Qayyum, Mehmood, Khan, Liaquat, Sohail and Ahmad, 2019). Analysis of Variance shows that the protein content was significantly ($p \leq 0.05$) different from each other. Protein content values of 6.44±0.06 and 5.73±0.01 for sweet and Irish potato observed in this study were higher than Polish potato variety (0.913g/100g) reported by Wszelaczynska, Poberezny, Lamparsky, Kozera and Knapowsky (2020), Rose and Vasanthakaalam (2011), Eleazu and Ironua, (2013) and Jin *et al*., (2016).). The proximate composition values in this study compares well with the range reported by Tsikrika *et al*., (2019) and Sato *et al*., (2017).

The result for mineral composition revealed that the mineral content values were higher in sweet potato when compared with those of Irish potato and there was significant difference in calcium, iron, magnesium, and sodium values for sweet and Irish potatoes and the higher composition was highly dependent on the soil agronomic practices, such as fertilization and Irrigation (Suarez, Hemandez, Galdon, Rodriguez, Cabrera, Mesa, Rodriguez-Rodriguez and Romero, 2016). The range value for Iron 1.27±0.06 for Irish potato recorded in this study is consistent with the values of 0.94 -3.94mg/100g reported for 13 Indian potato varieties by Wijesinha- Bettoni and Mouville, (2019) although a higher range of Iron content (1.24-2.52mg/100g) was reported by Fernandes, Soratto, Moreno and Evangelista (2015) in two potato varieties cultivated in Brazil. Calcium values of

25.83±0.29 for sweet potato and 15.27±0.06 for Irish potato recorded in this study are higher than the values of 5-11mg/100g reported by Fernandes *et al*., (2015) in Brazilian potato varieties. Jin *et al.*, (2016) and Ngobese *et al.*, (2017) also reported similar range of calcium content (5.25-9.31) and (5.2-10.2mg/100g) in four Korean and European varieties respectively. Potatoes are generally not valuable sources of calcium but due to lower phytic acid concentration, bioavailability of calcium from potatoes is relatively high (Fernandes *et al.*, 2015). Phosphorus value of 27.67±0.58 for sweet potato and 26.07±0.06 for Irish potato observed in this study were lower than the ranges of 33.00-63.27 and 43.5-47.7mg/100g reported by Jin *et al*., (2016) and Ngobese *et al* (2017) respectively. Phosphorus is among the main mineral present in tubers and is a healthy key player for healthy teeth, bones and cells (Navarre, Brown and Sathuvalli, 2019) and phosphorus uptake influencing phosphorus content in potatoes is important as it has been found to be positively related to tuber dry matter content and low content of total sugars Ngobese *et al*., 2017). Result for Vitamin composition revealed the absence of vitamin C and chlorophyll. There was no significant difference in vitamin A content for sweet and Irish potatoes (0.10±0.00) but however, there was significant ($p \leq p0.05$) difference for thiamine. Thiamine generally acts as a co-enzyme for numerous biological oxidation-reduction reactions such as energy metabolism and fatty acid oxidation. It is helpful in maintaining the integrity of mucous membranes, skin, eyes and the nervous system (Thakur, Tomar, Singh, Mandal and Arora, 2017).

The result for antinutrientional parameters showed that significant differences exist for saponin, tannin, and carotenoid values for Irish and sweet potatoes and phytochemical parameters observed in this study are polyphenol, flavonoid, and lignin with significant difference existing only for flavonoid values for Irish and sweet potatoes.

Fungi isolates identified in this study for Irish potato was *Candida sp*., *Penicillium sp* and *Aspergillus niger* while *Candida sp* was identified for sweet potato. The post harvest rot of sweet and Irish potatoes identified in this study may be due to moisture content and nutritional composition which make it susceptible to infection by fungi, prevailing climatic factors and storage conditions. It could also be attributed to handling procedures during harvest, transit, marketing and storage places. Post harvest rot of root and tubers has been of serious problem to farmers and warring against food security (Olurinola, Ehimmadu and Bonire, 1992).

In conclusion, sweet and Irish potatoes are rich in proximate, mineral and antinutrients but mould infestations are problem encountered during post harvest storage. Therefore, it is recommended that care should be taken during harvest, transit, marketing and storage places to reduce contaminations.

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