ANTIOXIDANT ACTIVITIES OF FLOURS FROM FOUR NIGERIAN RICE CULTIVARS

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Abstract
This study investigated the phytochemical constituents and antioxidant properties of four Nigerian local rice cultivars(*Bisalaye, MaduYankpa, Sipi*, and *Sharugi*). Rice paddy from the cultivars were dehulled and milled into flour using standard procedure. The total phenolic content (TPC), total flavonoid content (TFC), total anthocyanin content (TAC), 1,1-diphenyl-2-picrylhydrazil (DPPH) radical scavenging activity, and ferric reducing antioxidant power (FRAP) of the rice flours were determined using standard methods of analysis. Results obtained revealed that the TPC, TFC, TAC, DPPH and FRAP ranged ($p \leq 0.05$) from 1.36 to 2.01 mg GAE/ g, 41.53 to 48.92mg CE/ g, 1.14 to 1.60 mg/100 g, 81.90 to 87.41% and 0.85 to 1.37 mg TE/g, respectively. In addition,it was established that the antioxidant activities of the rice samples were in the order: *Sipi>MaduYankpa>Bisalaye>Sharugi.*Therefore, the rice cultivars are rich sources of phytochemicals and bioactive constituents for utilization in food systems. This drives the recommendation for detailed profiling of the nutritional composition, physicochemical and techno-functional propertiesof the flours for specific use in food product development.

Keywords: Nigerian rice,Indigenous cultivars, Phytochemical constituents, Antioxidant Potential

1.0 Introduction

Rice is the most important cereal crop in the developing world and the most staple food of over half the world's population (Liu, 2018). Rice flour is gluten-free with unique properties for diverse food applications. Nigeria is one of the largest producers of rice in Africa. There are several local rice varieties cultivated in Nigeria, which serve as source of food and income for the rural farmers. These rice varieties are cultivated alongside the improved varieties by farmers; thus, have potential to contributing to nutrition and food security in Africa.

In recent times, there is renewed interest in the consumption of local varieties of rice due to their low starch content and higher bioactive properties (Chinma*et al.*, 2015). There are reports that local rice varieties play a significant role in the promotion of health and wellness because of the abundance of micronutrients and bioactive constituents (Devraj*et al.*, 2020). In addition, the use of gluten-free cereals rich in phenolic compounds and antioxidant activities in the development of functional gluten-free cereal-based foods is gaining global interestdue to their

health benefits (Rocchetti*et al.*, 2019). Nevertheless, there is paucity of information on the quality characteristics including antioxidant properties of Nigeria's local ricevarieties in comparison to rice varieties from other major rice producing countries of the world such as China, Thailand, USA, among others. The objective of this study was to determine the phytochemical constituents and *in vitro* antioxidant properties of four Nigerian rice cultivars. Such information is expected to increase the utilization and potential of the rice cultivarsfor the promotion of food and nutrition security in Africa.

2.0 Materials and methods

2.1 Materials

Four Nigerian rice varieties (*Bisalaye, MaduYankpa, Sipi,* and*Sharugi*) were procured from National Cereal Research Institute Badeggi, Bida Niger State,Nigeria. All chemicals used were of analytical grade.

2.2 Preparation of rice flour

The rice flour was prepared as described by Chinma*et al.* (2018). Briefly, 2 kg of rice paddy from each cultivar were separately dehusked in a Satake rice husker (THU-35B, Satake Corporation, Japan) and brown rice samples obtained were polished in a Satake grain testing mill (model No. 553504, Satake Engineering Co., Japan) to obtain 8% degree of milling. Afterwards, rice grains from each cultivar were separately milled in a hammer mill (Globe P 44, Diamond Tools Co. Ltd. Henan, China), sieved (mesh size 100 μm) and stored in airtight plastic containers covered with lids.

2.3Profiling of total phenolic content and antioxidant potential

A standard procedure (Chinma*et al.*, 2014) was adopted in the preparation of methanolic extract (ME) used for profiling total phenolics and antioxidant activities. Accordingly, sample (0.2 g) was mixed with 4 mL of 80% methanol,and the mixture was centrifuged (at 4000 × g for 20 min). Afterwards, the supernatant was transferred into test tubes, evaporated (under nitrogen stream) and stored (at 4 °C). Samples were extracted in triplicate. The methanolic extracts of the samples were used for the analysisof total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activities. The TPC was determined according to Folin–Ciocalteau reagent method as explained byChinma*et al.* (2014) and expressed as mg GAE/g. The TFC was determined according to the method of Reddy*et al.* (2016) and reported as mg CE/g. The TAC (total monomeric-anthocyanin concentration) was assayed by the pH-differential procedure described by SutharutandSudarat (2012). The DPPH (1,1-diphenyl-2-picrylhydrazil) radical scavenging activity and ferric reducing antioxidant power (FRAP) weredetermined as described byChinma*et al.*(2014).

2.4 Statistical analysis

Results obtained were subjected to analysis of variance using a statistical software (SPSS 20, BM, Armonk, NY, USA). Tukey's test was used to determine significant differences (5% probability) among means.

3.0 Results and Discussion

The antioxidant activities of four Nigerian rice cultivars differed significantly ($p \leq 0.05$)(Table 1) and the results of the antioxidant parameters are above the valuespreviously reported by Chinma*et al.* (2015) for someNigerian rice cultivars (*Jamila, Jeep* and *Kwandala*which contained1.05 to 1.18 mg/GAE/g TPC and 1.01-1.04 mgmmol TE/g FRAP) as well as a popular Indian white rice variety, *Karudan samba* (1.91 mg GAE/ g TPC, 42.33 mg CE/g TFC, 82.56% DPPH and 0.83mg AAE/g reducing antioxidant power)(Meera*et al.*, 2019). It was observed that *Sipi* had the highest TPC, TFC, TAC, DPPH and FRAPwhile *Sharugi* had the lowest value (Table 1).It was also observed that antioxidant activities of the rice cultivars were in the order: *Sipi>MaduYankpa>Bisalaye>Sharugi*, whichcorroborates that antioxidant capacity is associated with the concentration of phytochemicalsin food materials. Moreover, phytochemical constituents have enormous antioxidant potential for the promotion of health and wellness (Mir *et al.*, 2016). From this perspective, the four Nigerian rice cultivars have potential health properties which could be utilized in the development of novel g foods.

4.0 Conclusions

This study demonstratedthat the four Nigerian rice cultivars are rich sources of phytochemicals and bioactive compounds. The study established that the antioxidant potential of therice cultivars were in the order:*Sipi>MaduYankpa>Bisalaye>Sharugi*. Nevertheless, information on the functionality of the flours is relatively scarce for specific use in product development. In the light of this, research is on-going in our laboratory on the nutritional composition, physicochemical and techno-functional properties of the riceflours in order to effectively utilize the flours in specific food formulation.

Table 1.Antioxidant activities of rice flour from four Nigerian rice varieties

Parameter	*Bisalaye*	*MaduYankpa*	*Sipi*	*Sharugi*
TPC (mg GAE/g)	1.54 ± 0.01^{c}	1.79 ± 0.01^{b}	2.01 ± 0.02^{a}	1.36 ± 0.01^{d}
Total flavonoid (mg CE/g)	44.67 ± 0.22^{c}	47.36 ± 0.19^{b}	48.92 ± 0.23^{a}	41.53 ± 0.27^{d}
Total anthocyanin (mg/100 g)	1.31 ± 0.01^{c}	1.45 ± 0.01^{b}	1.60 ± 0.01^{a}	1.14 ± 0.02^{d}
DPPH (%)	82.54 ± 0.13^{c}	84.23 ± 0.19^{b}	87.41 ± 0.25^{a}	81.90 ± 0.20^{d}
FRAP (mg TE/g)	1.02 ± 0.01^{c}	1.16 ± 0.01^{b}	1.37 ± 0.01^{a}	0.85 ± 0.17^{d}

The data from triplicate experiments are expressed as a mean ± standarddeviation.
Values with different superscripts in a row are significantly different ($p \leq 0.05$).
TPC= Total phenolic content,TFC = Total flavonoid content, TAC = Total anthocyanin content, DPPH = 1,1-diphenyl-2-picryl-hydrazilradical scavenging activity, and FRAP = Ferric reducing antioxidant power.

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