Assessment of nutritional composition and antioxidant ability of pearl millet (*Pennisetum glaucum*)

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ABSTRACT

Restrictions was placed on synthetic antioxidants due to their negative side effects, interest has thus increased considerably in finding natural antioxidants for use in foods, cosmetics or medicine to replace the synthetic ones. As a result of this, plants reported to exhibit antioxidant activity are relatively safe for consumption. Besides, whole grain products are recommended for healthy diets, good sources of dietary fibre and antioxidants substances.

This study was carried out to determine the nutritional composition and antioxidant ability of pearl millet (pennisetum glaucum). Methanol extract of the millet sample was evaluated for antioxidant properties in the study. An assessment of its antioxidant potential was determined using reducing property, total phenolic content and scavenging activity on 2, 2-diphenyl-1-picrylhydrazyl (DPPH). The result show that pearl millet possesses high phenolic content, moderate reducing ability and high free radical scavenging activity and therefore can serve as a source of antioxidants in our diets.

Keywords: antioxidant, millet, nutritional composition.

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INTRODUCTION

Millets are group of small-seeded species of cereal crops or grains, widely grown around the world for food and staples. Their essentials similarities are that they are small-seeded grown in difficult production environments such as those at risk of draught. [1].

Millets have been common food staples in human history, particularly in the semi-arid tropics of Asia and Africa. Improvements in production, availability, nutritional content, storage and utilization technology for millets may significantly contribute to the household food security of these areas [2].

The millets include species in several genera, mostly in the sub-family panicoideae, of the grass family poaceae. The height of the pearl millet plant may range from 0.5 to 4 meters. The millet grains can be nearly white, pale yellow, brown, grey, slate blue or purple. The ovoid grains of the pearl millet are about 3 to 4 mm long, much longer than those of other millets. The seeds usually weigh between 2.5g and 1.4g, with a typical mean of 0.8g. The size of the pearl millet kernel is about one-third that of sorghum. The relative proportion of germ to endosperm is higher in pearl than in sorghum[3].

Millets porridge is a traditional food in Russian, German and Chinese cuisines. Millet is estimated to account for about 35% of total cereal food consumption in Burkina Faso, Chad and Gambia. In Mali and Senegal, millets constitute roughly 40 per cent of total cereal food consumption per capital, while Niger and Arid Namibia it is over 65%, other countries in Africa

where millets are common food source include Ethiopia, Nigeria and Uganda[2]. Millets like sorghum are predominately starchy.

Antioxidants are substances that protect cells from damage caused by unstable molecules known as free radicals. Cellular damage or oxidation injury caused by these free radicals or reactive oxygen species which are generated through normal metabolism of drugs, environmental chemicals and other xenobiotics as well as endogeneous chemicals appears the fundamental mechanism underlying a number of human diseases such as neuro-degenerative disorders, diabetes mellitus, nephritis, rheumatism, Alzhiemer disease, cataracts, cardiovascular diseases, acute liver toxicity, inflammation, viral infections, digestive system disorders and DNA damage that can lead to carcinogenesis. The bran layer of millets are good sources of B-complex vitamins. However, millet also feature high fibre contents and poor digestibility of nutrients, which severely limits their value in nutrition and influence their consumer acceptability [3].

The action of one antioxidant may therefore depend on the proper function of other members of the antioxidant systems [4].The amount of protection provided by any one antioxidant will also depend on its concentration, its reactivity towards the particular reactive oxygen species being considered, and the status of the antioxidants with which it interacts.

MATERIALS AND METHODS

Sample preparation

The millet grains were purchased at Apata Market in Ibadan, Oyo State, Nigeria. It was identified and authenticated by a plant taxonomist at Federal Colleges of Animal Health and Production Technology, Moor Plantation, Ibadan, Nigeria.

Fermentation

3kg of the pearl millet was soaked in water for 72hours in a container after the impurities (such as stones, chaffs and others) present in the millet has been sorted.

Grinding

After the three-day fermentation, the water was drained and the fermented millet grains were ground to paste by using grinding machine.

Sieving and concentration

The pearl millet paste was sieved into another container using muslin cloth and the residue was discarded while the filtrate was allowed to settle down in the container. The water floating on top of the sediment was decanted into the sink in order to concentrate the sample.

Oven-drying

The concentrated millet sample was spread in a tray and was allowed to oven-dry at 40 ^{0}c until it became powder which was used for extraction.

Extraction of sample for antioxidant determination.

The methanol extract of the pearl millet was obtained by soaking 50g of dry powdered sample in 500ml of methanol for 24hrs.The extract was filtered using Whatman filter paper (125 mm) into a clean bottle and stored in the freezer for further use.

Reducing property determination

The reducing property of the sample was determined by assessing the ability of the sample to reduce iron (III) chloride ($FeCl_3$) solution as described by Pullido *et al* [5].Appropriate dilutions of the extract ranging from 10% (v/v) to 50% (v/v) were mixed with 2.5 ml sodium phosphate and 2.5ml potassium ferrocyanide. The mixture was incubated at 50^{o}C for 20 minutes. Thereafter, 2.5ml of trichloroacetic acid was added and finally 2.5ml of 0.1% ferric chloride was added. The absorbance of the resulting mixture was then measured with UV/Visible spectrophotometer at a wavelength of 700nm. A higher absorbance indicates a higher reducing power.

Determination of free radical scavenging ability

2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay was used to measure the free radical scavenging ability of the pearl millet extracts using the methods of [6-8] with little modifications. 1ml of 0.1mM DPPH prepared in methyl alcohol was mixed with 3ml each of the methanol extract with different concentrations ranging from 10 to 50mg/ml. The reaction mixture was thoroughly vortexed and left in the dark at room temperatures for 30minutes. A light yellow coloration was observed. The absorbance of the resulting solution was then measured using spectrophotometer at a wavelength of 517nm. Ascorbic acid and gallic acid were used as standards and distilled water used as blank. A decrease in the absorbance of the reaction mixture indicated higher radical scavenging ability.

The scavenging ability of the methanol extract of the pearl millet sample was calculated using the equation:

Scavenging effect = [1-(Ai-Aj)/Ac] x100%

Where Ai is the absorbance of the test sample mixed with the DPPH solution; Aj is the absorbance of the sample without DPPH solution; Ac is the absorbance of the DPPH solution without sample.

RESULTS

Figure 1 shows that at different concentration of 10.0% v/v, 20.0% v/v., 30.0% v/v, 40.0% v/v, 50.0% v/v, the reducing ability increases with increase concentration of the extract. The result shows that there is an increase in the ability of the extract of pearl millet to reduce Fe (III) to Fe (II).

Figure 2.0 shows the total phenolic content of pearl millet.0.19, 0.46, 0.85, 1.10 and 1.50 were obtained as the values for different concentrations of the pearl millet extracts increases from 10% v/v to 50.0% v/v. Higher concentrations indicate higher phenolic contents of the pearl millet extracts increase with concentrations.

Figure 3 shows the free radical scavenging of the pearl millet extracts. As the concentration increases from 10.0% v/v to 50.0%v/v, the free radical scavenging ability of the pearl millet extracts also increases from 33.33 to 93.33.

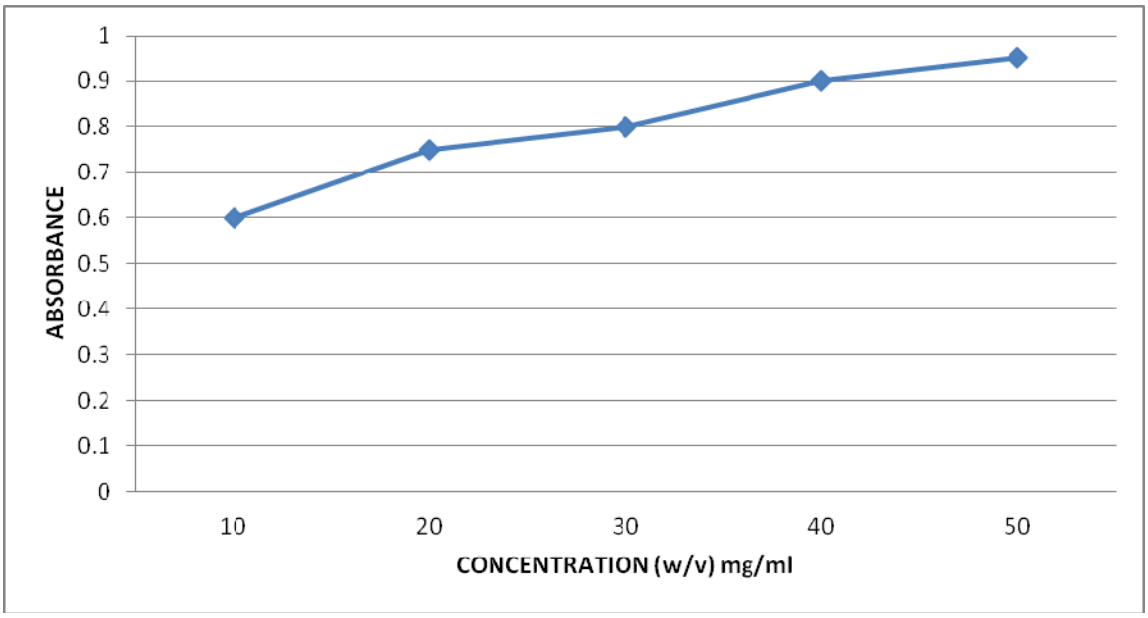

Figure 1: Reducing property of millet.

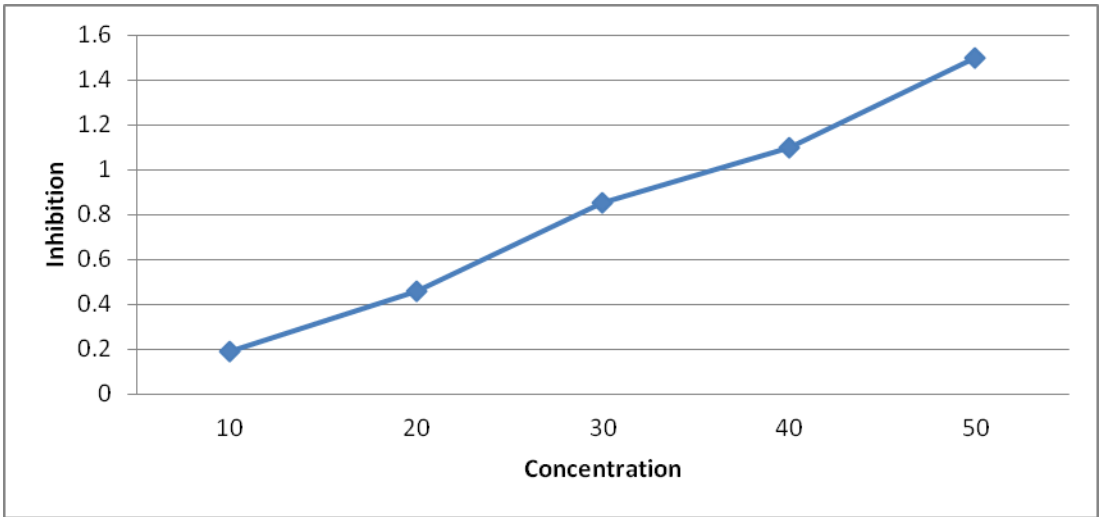

Figure 2 Phenolic content of pearl millet.

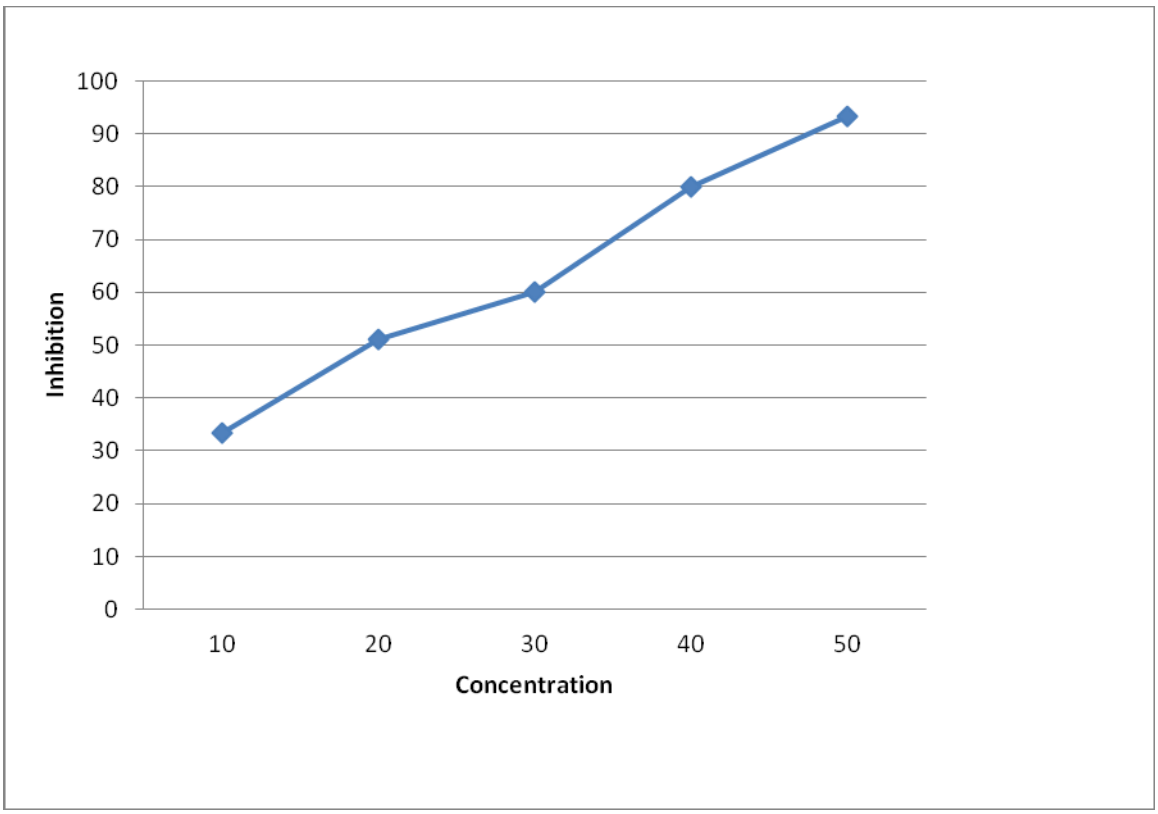

Figure 3: Free radical scavenging ability of pearl millet

Table 1: Nutritional composition of unfermented and fermented millet sample

Parameters (%)	Unfermented millet	Fermented Millet
Moisture content	6.58	33.62
Dry matter	93.42	66.38
Ash content	4.00	1.30
Crude fibre	25.20	9.90
Ether extract	2.00	5.00
Crude protein	7.95	8.61

DISCUSSION

The nutritional composition, reducing property, total phenol content and scavenging activity on 2,2 -diphenyl-2-picrylhydrazyl (DPPH) of pearl millet extracts were evaluated in this study.

Table 1 shows the nutritional composition of unfermented and fermented millet samples. These values are higher than what was reported by [9] for pearl millet (8.0) and Oat (7.9). The protein in millet consists of all varieties of essential amino acids including leucine. It is a good source of Tryptophan, an amino acid which can raise serotonin level and helps stress reduction.

Also, from the result obtained in this study, pearl millet possesses ability to serve as reducing agent and therefore can serve as a source of antioxidants which counter the accumulation of free radicals in the body. This finding agrees with the report of [10] that antioxidants are reducing agents. The result also agrees with the earlier findings of [11] on reducing power of pepper.

Phenols and phenolic compounds have been reported to possess significant antioxidant activities [7]. From table 1, pearl millet extracts, showed that an increase in concentration leads to an increase in the total phenolic content. The total phenolic content of pearl millets is higher than what was reported by [12] for fermented African locust bean. This indicates that regular consumption of pearl millet may serve as a dietary source of antioxidants. Also, the values obtained were higher than what was obtained for Carica papaya and Cajanus cajan by [13].These higher values agree with report of [14] that fermentation of cranberry pomace improved phenolic content and antioxidant activity.

Plants with antioxidant activities have been reported to possess free radicals scavenging activity. free radicals are the major contributors to severe diseases and disorders such as cancer, diabetes, liver diseases, renal failure and degenerative diseases as a result of minimal or deficient natural

antioxidant defense mechanism [7],[15].The pearl millet used in this study shows high free radicals scavenging activity and therefore can serve as a source of antioxidants in our diets.

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