

ORIGINAL ARTICLE

Effect of Roasting on Whole Grain Barnyard Millet to the Proximate Composition, Amino Acid Profile, Total Phenolic Content and Antioxidant Activity

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ABSTRACT

Introduction: Barnyard millet, an ancient grain that serves as a staple food and a key component of many diets, requires processing before consumption. Roasting is a common processing method that can enhance millet palatability. However, it is important to ensure that the nutritional properties are well preserved. Hence, this study investigated the influence of roasting on the proximate composition, amino acid composition, total phenolic content (TPC) and antioxidant activity of the whole grain barnyard millet sample. **Method:** The roasted sample of whole grain barnyard millet was roasted in the oven at 110°C for 10 minutes and used for proximate analysis and amino acid composition. Meanwhile, TPC and DPPH were performed using the ethanol extract of a roasted whole-grain barnyard millet sample. **Results:** This study found a significant ($p < 0.05$) of 14.22% reduction in moisture content in roasted millet compared to non-roasted millet. The roasted millet sample showed a higher fat content ($p < 0.05$) compared to the non-roasted millet sample, with values of $5.08 \pm 0.24\%$ and $4.38 \pm 0.24\%$, respectively. The total amino acid content of the non-roasted sample was $116.76 \pm 11.31 \text{ ng}$, while the roasted sample had a value of $123.51 \pm 0.23.22 \text{ ng}$. In addition, the TPC and antioxidant activity were found significantly higher ($p < 0.05$) in the roasted sample than in the non-roasted sample of whole grain barnyard millet. **Conclusion:** The roasting method should be considered in processing of the whole grain barnyard millet to enhance the nutrient composition and boost its functionality.

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INTRODUCTION

Cereals, which are considered a vital food group and the primary source of nutrients for humans, encompass a variety of grain types, including millets. Millets are an ancient grain that are traditionally utilized for feeding birds and animals and now are gaining importance due to its nutritional properties making them a valuable addition to human diets. Millets are consumed in various parts of the world as a staple food, majorly in Africa and Asia region. Millet grains can be consumed as ingredients in varied food and serve as highly nutritious food (1). Besides, millets are also free from gluten which makes them suitable for individual with celiac disease.

Barnyard millet is a variety of millet that stand out as one of the most commonly cultivated minor millet in low

income countries and holds the potential in solving the food security issue in the poor region. Barnyard millet is cheaper than other staple cereals such as rice, wheat and maize because it can be raised at low management cost (2) attributed to its characteristic resistance to extreme conditions of drought, insect pests and disease and also has a short growing season (3). Apart from that, barnyard millet also possesses immense health benefits because of its high source of carbohydrates, protein, dietary fiber, micronutrients of iron, zinc, calcium, magnesium, fats and essential amino acids (4,5). Barnyard millet is also well known for its antioxidant properties, anti-carcinogenic, anti-inflammatory and anti-microbial properties (6) by the presence of polyphenols and other bioactive compounds in the barnyard millet (7).

Barnyard millet is consumed in versatile ways such as porridges, and sweet dishes, and also processed to form biscuits, noodle rusk and popped products (8). Different processing techniques are applied to it before new products are produced with higher palatability and longer storage. Roasting is one of the commonly used

processing methods of cooking. Roasting is also known as one of the traditional processing techniques where dry heat is applied to food products (9) that is usually used to enhance the texture of crispiness and crunchiness and also the color of the food product. In addition, the physical characteristic attributed to the roasting process, particularly in cereals, have been found to be able to remove the antinutrient and the toxic effects that the cereals contain (10). Furthermore, the effect of heat from roasting also can increase the accumulation of secondary metabolites in the food component such as phenolic compounds (11).

The process of roasting refers to the application of heat treatment to induce several changes in the physical appearance, taste profile, chemical composition and modifications of the nutritional value (12). Several studies have shown an increase in proximate value particularly on major millet upon the roasting process. A study done on finger millet found an increase in the proximate value of carbohydrate, ash, fat, fiber and protein content of roasted millet (13). Roasting of another major millet, proso millet also shows an increase in the total phenolic, flavonoids and antioxidant activity (14). While significant focus has been given to the processing methods and the nutritional content of major millet, there is lack of studies done on minor millet. In addition, detailed information on dry heat processing to the minor millet specifically on barnyard millet is rather scarce. Hence, this study was carried out to investigate the effect of roasting on whole grain barnyard millet to the proximate composition (carbohydrate, protein, fat, total dietary fiber and available carbohydrate), amino acid profile, total phenolic content and the antioxidant activity (2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity). The new insight of processing method on this millet could improve the versatility of healthy diet to the consumer.

MATERIALS AND METHODS

Materials

For whole grain barnyard millet, the grain was purchased originally from India. For protein analysis, Kjeltabs Cu-3.5, FOSS was purchased from Fisher Scientific (New Hampshire, United States), and sulphuric acid and hydrochloric acid were from brand R&M Chemical, purchased from Ever Gainful Enterprise Sdn. Bhd. (Selangor, Malaysia). Boric acid was purchased from Sigma-Aldrich (Darmstadt, Germany). Petroleum ether used for fat analysis was obtained from Fisher Scientific (Loughborough, UK). Megazyme Total dietary Fiber Assay Kit K-TDFR-100A which includes thermostable α -amylase, purified protease and purified amyloglucosidase was purchased from Megazyme Ltd. (Bray, Ireland). Phosphate buffer and celite were purchased from Sigma-Aldrich (Darmstadt, Germany). Besides, ethanol and acetone were obtained from R&M Chemical (Selangor, Malaysia). For the amino

acid profile, hydrochloric acid, AccQ Fluor Borate Buffer, AccQ Fluor Reagent, L-Hydroxyproline, L-2-Aminobutyric Acid, 17 amino acid standards, AccQ Tag Eluent A was purchased from Sigma-Aldrich (Darmstadt, Germany). For total phenolic content and antioxidant analysis, phenolic acid standards (gallic acid), Folin-Ciocalteu reagent, sodium carbonate, methanol, 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), 2,2-diphenyl-1-picrylhydrazyl (DPPH) were product of Sigma-Aldrich (Darmstadt, Germany).

Millet preparation

The millet was first cleaned accordingly by winnowing to separate the grain from the chaff followed by visual screening to detect and remove any foreign materials. For the roasting process, the method was followed according to previous study where the grain was roasted at 110 °C for 10 minutes in the convection oven (15). Once the roasting was done, the grain was cooled and was grounded into a fine powder using a heavy-duty blender. The flour was sieved and stored at 4 °C for future use. For non-roasted millet, a similar procedure of grinding and storing was done.

Proximate composition

Analysis of moisture, ash, protein, fat and total dietary fibre of samples was determined according to the Association of Official Analytical Chemists (AOAC). The moisture content was determined through the hot air oven method (AOAC 990.19, 2016). The dry ashing method (AOAC 999.11, 2016) was employed to determine the ash content. The Kjeldahl method (AOAC 973.48, 2016) was used to determine the protein content, while the fat content was determined using the Soxhlet method (AOAC 960.39, 2016). The enzymatic Megazyme method (AOAC 991.43, 2016) was used to determine the dietary fiber content. Finally, the available carbohydrate was calculated by percentage difference by using the formula as mentioned:

$$\text{Carbohydrate}\% = 100 - (\%_{\text{Moisture}} - \%_{\text{Ash}} - \%_{\text{Protein}} - \%_{\text{Dietary Fiber}})$$

Amino acid profiling

For amino acid profiling, both samples were sent to Halal Services Laboratory, Halal Products Research Institute, Universiti Putra Malaysia for analysis. Briefly, 0.2g of sample was used for this analysis. Then, the samples were added with 5mL of hydrochloric acid followed by heating the sample at 110°C for 24 hours. The hydrolysate samples were added with 4mL of internal standard α -amino butyric acid (AABA). The hydrolysate mixture was marked up with water in a 100mL volumetric flask. Then, the hydrolysate solution was filtered by using a 0.45 μ m syringe filter. In an Eppendorf tube, 70 μ borate buffer was added followed by 10 μ L of filtered hydrolysate samples. After that, the mixture was vortexed to homogenise. 20 μ L of AccQ Fluor reagent was added and continued vortexed. Once done, the mixture stood for one minute at room temperature. The

mixture was then transferred into vials and heated for 10 minutes at 55°C. The samples were then injected into High-Performance Liquid Chromatography (HPLC) brand Waters (Alliance e2695) with a Fluorescence detector (2475-waters). The column used was AccQ tag column (3.9mm X 150mm) with mobile phase AccQ Tag and Deionised water (1:10) for mobile phase A, acetonitrile for mobile phase B and water for mobile phase C. Column temperature was set at 36°C with flow rate 1mL/minutes. The injection volume was set for 10µL. The reference standard was consisting of 16 amino acids at 2.5mM certified concentration and cystine at 1.25mM. The amino acid content in each samples was represented in ng of 10 µL injection of 0.212g of weighted samples.

Extraction of millet

Extraction of millet flour was done according to the protocol from previous study (15) with slight modifications. In brief, 1g of millet flour sample was weight and dissolved in 100 mL of 80% (v/v in water) of ethanol. Then, the sample was sonicated at 35°C for 60 minutes. Then the sonicated extract was filtered using filter paper followed by evaporation using a rotary evaporator (Buchi Rotary Evaporator, Diagonal Condenser, East Bunker Ct Vernon Hills, United States) set at a temperature of 40°C to yield the crude extract. Finally, the stock solution was prepared by diluting the crude extract with distilled water (1mg/mL) and stored at -20°C for future investigation.

Total phenolic content

The analysis of total phenolic content (TPC) was following the 96-well microplate Folin-Ciocalteu method from past study (16). A 20µL of diluted extract (1mg/mL) was pipetted in the microplate well and mixed with 100µL of Folin-Ciocalteu reagent and shaken for 1 minute on Stovall belly dancer. Then, the mixture was left for 4 minutes and then 75µL of sodium carbonate solution (7.5%) was added into the mixture and shaken continuously at minimum speed for 1 minute. The mixture was then left at room temperature for 2 hours and the absorbance of the sample was measured at 750nm using a microplate reader. The absorbance of the same reaction for blank using water was subtracted from the absorbance of the reaction with the sample. Gallic acid as standard at a dilution 10-100mg/L was used as a standard for calibration. The results were expressed in mg GAE/g of dry weight extract and calculated using the following formula:

$$C=C_1 \times V/m$$

Where C was total phenolic content in mg/g, in GAE (Gallic acid equivalent), C_1 was the concentration of the Gallic acid obtained from the calibration curve in mg/mL, V was the volume of extract in mL and m was equal

to the weight of plant extract in g.

DPPH free radical scavenging activity

The antioxidant activity of the samples was analysed by the ability of the extracts to scavenge free radicals of 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical activity by the method from previous study (16). The extracted sample was diluted with methanol at 1mg/mL and then further diluted to obtain a concentration of 25µg/mL and 50µL of the sample was used for the test. The sample was pipetted in the well of 96 well plates and mixed with 195µL of 100µM DPPH solution that was prepared in methanol. After 30 minutes, the absorbance of the reaction mixture was read at 515nm using a microplate reader. Different concentration (0-200µg/mL) of known antioxidant standard Trolox was used as positive control. The results of the analysis were presented as percentage (%) DPPH free radical scavenging activity calculated with the following equation:

$$\text{Scavenging activity (\%)} = \frac{(\text{absorbance of control} - \text{absorbance of sample}) \times 100}{\text{absorbance of control}}$$

Statistical analysis

All analyses were done in triplicate and the results were expressed in mean and standard deviation. The data were statistically analysed using Statistical Package for Social Sciences (SPSS) version 27 software (IBM, Armonk, NY, USA). An independent t-test was used for the comparison of means between groups and the level of significance was set at $p < 0.05$.

RESULTS

Proximate analysis

The proximate contents associated with the moisture, ash and major micronutrients of fat, protein, total dietary fibre and carbohydrates in the whole grain barnyard millet was shown in Table I. The moisture content of the samples ranged from 17.49% to 31.71%. The non-roasted millet sample had a higher moisture content compared to the roasted millet sample, which showed a significant reduction ($p < 0.05$) of 14.22% in moisture content when compared to the non-roasted sample.

The results obtained from this study shows the ash content of the non-roasted and roasted sample was at 5.03% for both sample and there was no significant difference between both samples. Next, the fat content between the non-roasted and roasted millet sample was in range of 4.38-5.08%. Between both samples of millet, roasted millet shows a significantly higher ($p < 0.05$) fat content compared to non-roasted millet sample.

The protein content for non-roasted and roasted millet was found to be 8.42% and 8.72% respectively. Both analysed millet samples do not show a significant

difference between non-roasted and roasted millet. However, it can be noticed from Table I that the roasted millet contains higher crude protein which increase at 0.3%.

The total dietary fibre of non-roasted and roasted barnyard millet was at 22.66% and 23.19% respectively. Roasting of millet sample showed a slight increase of 0.53% for the dietary fiber content compared to the non-roasted millet sample. However, there were no significant difference can be observed between both samples.

The total carbohydrate content in non-roasted and roasted millet sample was observed at 30.95% and 40.13% respectively. It can be observed from Table I that the available carbohydrate of roasted millet was higher, and total carbohydrate was increased by 9.18% after roasting although there was no significant difference when comparing with non-roasted millet.

Table I: Proximate analysis of whole grain barnyard millet samples.

Variables	Non-Roasted Millet	Roasted Millet
Moisture (%)	31.71 ± 0.71*	17.49 ± 0.89*
Ash (%)	5.03 ± 0.06	5.03 ± 0.06
Fat (%)	4.38 ± 0.34*	5.08 ± 0.24*
Protein (%)	8.42 ± 0.11	8.72 ± 0.32
Total Dietary Fiber (%)	22.66 ± 4.46	23.19 ± 2.05
Available Carbohydrate (%)	30.95 ± 4.16	40.13 ± 9.66

Data represent mean ± standard deviation of triplicate readings. Values with the asterisk symbol along the same row are significantly different ($p > 0.05$).

Amino acid composition

The amino acid composition of non-roasted and the roasted whole grain barnyard millet was tabulated in Table II. The total amino acid compound of non-roasted was 116.76 ± 11.31ng and for roasted sample was 123.51 ± 23.22ng. Overall, there was no significant difference in each of amino acid compound between both samples. However, it is noticeable that the roasted millet has a higher value of each amino acid content compared to the non-roasted except decrease in cysteine, methionine and hydroxyproline has not changed.

Total Phenolic Content (TPC)

The total phenolic content of non-roasted and roasted barnyard millet were shown in Table III. From this study, the total phenolic content of whole grain barnyard millet, in non-roasted millet was 0.031 mg GAE/g and in the roasted sample was 0.042 mgGAE/g. The results for both samples was significantly difference ($p < 0.05$) and the roasted sample have higher value of total phenolic content compared to the non-roasted sample.

DPPH free radical scavenging activity

The results of the DPPH radical scavenging activity between non-roasted and roasted samples were shown in Table IV. The percentage of DPPH radical scavenging activity for non-roasted and roasted millet was 1.356%

Table II: Amino acid compound of whole grain barnyard millet samples.

Amino Acid Compound/ Variables (ng)	Non-Roasted Millet	Roasted Millet
Hydroxyproline	0.995 ± 0.36	0.995 ± 0.39
Aspartic Acid	7.888 ± 0.80	8.670 ± 0.86
Serine	6.111 ± 0.44	6.554 ± 1.19
Glutamic Acid	26.023 ± 2.37	27.552 ± 3.78
Glycine	3.724 ± 0.16	4.035 ± 0.58
Histidine	2.499 ± 0.14	2.723 ± 0.45
Arginine	4.900 ± 0.43	5.226 ± 1.09
Threonine	4.350 ± 0.34	4.687 ± 0.93
Alanine	10.259 ± 1.86	10.853 ± 2.74
Proline	8.958 ± 0.63	9.691 ± 1.84
Cysteine	0.547 ± 0.12	0.526 ± 0.03
Tyrosine	3.411 ± 0.06	3.474 ± 0.56
Valine	6.857 ± 0.85	7.312 ± 1.65
Methionine	2.167 ± 0.18	2.072 ± 0.53
Lysine	3.671 ± 0.38	3.900 ± 0.67
Isoleucine	5.726 ± 0.61	6.069 ± 1.26
Leucine	12.137 ± 1.69	12.946 ± 3.10
Phenylalanine	6.176 ± 0.48	6.602 ± 1.32
Total Amount of Amino Acid	116.761 ± 11.31	123.509 ± 23.22

Data represent mean ± standard mean error of triplicate readings. The amino acids were detected in 10 µL injection of 0.212g of weighted samples.

Table III: TPC value of whole grain barnyard millet samples.

Sample	TPC Value (mg GAE/g)
Non-Roasted	0.031 ± 0.001*
Roasted	0.042 ± 0.001*

Data represent mean ± standard mean error of triplicate readings. Values with the asterisk symbol along the same column are significantly different ($p > 0.05$).

Table IV: DPPH radical scavenging activity of whole grain barnyard millet samples

Sample	% DPPH Radical Scavenging
Non-Roasted	1.356 ± 0.191*
Roasted	2.231 ± 0.076*

Data represent mean ± standard mean error of triplicate readings. Values with the asterisk symbol along the same column are significantly different ($p > 0.05$).

and 2.231% respectively. There was a significant difference ($p < 0.05$) between the percentage of DPPH radical scavenging activity. The roasted millet shows the highest value of the radical scavenging activity with at 0.875% difference with non-roasted millet.

DISCUSSION

The application of heat to the sample lead to the changes state of water in the sample by involving

evaporation process. From the result, the roasted whole grain barnyard millet sample exhibited a reduction of 14.22% in moisture content compared to the non-roasted millet sample due to the removal of water by the high temperature of roasting. Previous research also reported reductions in moisture content after roasting, with roasted finger millet showing a reduction of 2.67% and roasted pearl millet showing a reduction of 1.60% (10,17). The reduction of water in roasted millet will eventually lower the water activity in the grain. Hence, roasting of the millet will contribute to better preservation and increased shelf stability similarly supported from previous study of roasted brown rice (18). The longer shelf life resulting from the reduction of water during the roasting process provides added convenience for utilizing barnyard millet, particularly in the form of millet flour, allowing for greater flexibility and availability in various culinary applications.

The ash content reflects the mineral and any inorganic materials left after the food sample was incinerated. The results of ash was correspond to the study of using low roasting temperatures at 110°C for 10 minutes for foxtail millet samples conducted by past study (19), where the ash content for non-roasted foxtail millet and roasted sample obtained at 1.42% and 1.41% respectively. The reason behind this was because of the temperature (110°C for 10 minutes) used for roasting in this study was using minimal heat for roasting. Another study further supported this observation by showing that roasting millet at high temperatures of 180°C led to a higher ash content at 0.53% difference compared to the non-roasted millet sample (17). Reported from previous study, roasting of the millet cause a reduction in phytic acid due to the thermal treatment, consequently could result in an increase in mineral content (13). As a mild temperature was used for roasting treatment in this study, the mineral release from the degradation of nutrient compound does not take place.

The significant increase in fat content upon roasting of the millet in this study is in contrast to previous results with roasted white finger millet, where the fat content was lower upon roasting (13). This decrease was attributed to the destruction of fat during the treatment process and the formation of starch-lipid complexes that are resistant to lipid extraction (10,17). However, a similar increasing trend (3.34% increase) in fat content upon roasting was observed in a study that investigated protein maize (20). The significant increase in fat content of the roasted millet may be associated with the effect of heat on the breakdown of the bond that exists between the fat and the matrix of the millet thus, results in the mobilisation of oil reserving in the millet coming out upon roasting (21).

For crude protein, the roasted sample shows the higher protein content than the non-roasted whole grain barnyard sample. These findings were in agreement with

the previous study by earlier study (22), which reported that roasted foxtail and barnyard showed an increased value (1.6%) in crude protein. The increase of crude protein in the roasting treatment sample was due to the usage of the low temperature of roasting in this study which led to the production of secondary metabolites which consist of protein. Thus, this will increase the protein content upon roasting at a low temperature. This suggest that the roasting process of barnyard millet is advised to be conducted at low temperature to optimize the availability of protein in the grain and prevent from protein denaturation, thereby facilitating the body's utilization of the available protein in roasted barnyard millet.

The findings of total dietary fibre from this study was in line with past study of roasted finger millet which increase at 7.4% of total dietary fibre after roasting process (10). This suggest that roasting the barnyard millet can enhance its digestibility as dietary fibre are recognized for their role in promoting digestion. Additionally, dietary fibre comprises total undigested carbohydrate and lignin (10) and its aids in the regulation of sugar in the body that prolonged satiety feelings and helps to prevent and release constipation (23). The high amount of dietary fibre also helps to maintain a healthy gut by promoting the growth of good bacteria in the gut that can stimulate the production of short-chain fatty acids (24).

The results of total available carbohydrate from this study were in agreement with the previously studies on roasted pearl millet at 2.94% and finger millet at 3.38% higher compared to the non-roasted sample (10,17). Since the total carbohydrate was calculated by difference, a decrease in moisture content after roasting will ultimately affect the value of carbohydrate content, hence we can see the observed increase in the total carbohydrate content (21). The increase of available carbohydrate of roasted whole grain barnyard millet in this study has demonstrated its potential as a valuable energy source for inclusion in everyday diets. This versatile grain can be utilised in a variety of millet-based product such as millet bread, millet-based breakfast cereals, or energy bar that offering an energy rich option for individual seeking a sustainable dietary alternative.

The higher value of amino acid for roasted millet was in this study contradict with the previous study of whole grain pearl millet (17). The decreasing value of amino acid resulted in the previous study was due to the usage of high temperature (180°C for 10 minutes) of roasting that cause degradation of heat-sensitive amino acid in the sample. Another study which investigated the effect of roasting on different cereals of protein maize (20), found an increase level of and lysine that matched with present study. Glutamic acid was the most concentrated amino acid for both samples of millet. Glutamic acid has been linked with its biological role in functioning as

a neurotransmitter which is an intermediate compound in many fundamental biochemical reactions (25).

Besides, leucine was the most abundant essential amino acid in both samples of barnyard millet followed by valine and phenylalanine. The current study's findings on the amino acid content of proso millet were consistent with the results from this present study which reported high level of in leucine and phenylalanine (26). Histidine, threonine, methionine and lysine was also important amino acids that is required in the daily human diet. The total amino acid of roasted barnyard millet resulted in a higher value at 6.75% difference than non-roasted millet. Thus, roasting the barnyard millet could enhance the intake of both essential and non-essential amino acid in the diet making it a more valuable component of a balanced and nutrient-rich diet.

The phenolic compound was the valuable plant constituent which contain hydroxyl group that responsible for facilitating free radical scavenging (27). Hence, the phenolic content was measured using Folin–Ciocalteu reagent in ethanolic extract in this study. The results of total phenolic compound (TPC) in this study were consistent with previous findings of whole-grain broomcorn millet (15). Roasting was one of the processing methods that can boost the accretion of secondary metabolites. One of the reasons roasting can increase the TPC value is because during the roasting process, the phenolic compound that accumulated in the vacuoles of the cell oozes out due to the breakdown of the cellular constituent and membranes such as cell wall (14). Other than that, the heat transfer to the sample during roasting could assist the process of C-glycosyl flavones and subsequently release the phenolic compound that binds in the barnyard millet (15). The Maillard reaction during the heating of the millet also could develop varieties of by-products which could contribute to the increase of the TPC value. The elevation of the phenolic content on the roasted barnyard millet could offers potential health benefits including enhanced antioxidant activity attributed from the phenolic compound from the grain.

The DPPH radical is one of the commonly used substrates to evaluate the antioxidant activity by observing the ability of the compound to reduce the DPPH radical determined by decrease in the absorbance at 517 nm. The results were in conjunction with the past study of different roasted millet (14,15). The DPPH radical scavenging activity reflects the antioxidant properties in the sample. Roasting alters the composition of bioactive compounds in the barnyard millet and consequently. This will affect the antioxidant properties of the sample (28). The contribution of the antioxidant activity by roasting process might be due to the creation of Melanoidins upon roasting at the optimum temperature (29). The formation of Melanoidin was contributed during the non-enzymatic browning reaction happened during

roasting. This finding highlights the potential of roasting as a process to enhance the antioxidant properties of whole grain barnyard millet, making it valuable addition to health-conscious diet. For instance, incorporating roasted barnyard millet into baked good such as granola bar or biscuit shows its versatility as an antioxidant-rich food product.

CONCLUSION

In conclusion, this study accentuates the effect of roasting on the composition of whole-grain barnyard millet. Roasting at 110°C for 10 minutes of whole grain barnyard millet can significantly change the nutritional values of moisture, fats, TPC and radical scavenging activity of the whole grain barnyard millet. Besides, roasting also shows no effect on several nutritional values, such as ash, protein, dietary fibre, available carbohydrate in addition to increment of antioxidant properties showing a good processing method in preservation of nutritional values of barnyard millet. The study also highlighted that the amino acid present in whole grain barnyard millet is abundant in health-promoting benefits. Therefore, whole grain barnyard millet is a nutritionally beneficial dietary option and offering a numerous of uses, while roasting serves as a good cooking method to enhance the functional properties of food and maximize nutritional benefits especially in roasted whole grain barnyard millet.

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