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Evaluation of Millet Bran for Yield, Proximate and Phytochemical Compounds as Influenced by Varieties and Processing Methods in Sokoto, Nigeria

Allah YN* and Tijani N

Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University, Nigeria

***Corresponding author:** Na-Allah Y, Department of Animal Science, Faculty of Agriculture, Usmanu Danfodiyo University, Nigeria, Tel: +234(0)8069791901; Email: yakubunallah@gmail.com

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Abstract

In this study, millet bran from three millet varieties (*Gero, Maiwa and Gajaga*) obtained from the traditional (manual) and modern (mechanized) processing methods were evaluated for proximate and some phytochemical compounds. The 3 x 2 treatments were factorially combined and laid out in complete randomized design (CRD) each replicated three times. Two measures (about 5 kg) each of *Gero, Maiwa and Gajaga* millet varieties were purchased from the grain section of Sokoto central market and divided into two equal parts, which were processed separately, using the traditional (manual) and modern (mechanized) processing methods. The bran obtained after milling from each of the millet variety and processing methods were air dried and weighed to obtain the bran yield expressed as percentage of weight of the millet sample used. The air dried bran samples were then evaluated for proximate and some phytochemical compounds using standard procedures. The results obtained showed that the DM of brans from manually processed millet varieties were significantly ($P < 0.05$) lower than the mechanically processed. The DM content of Gajaga millet bran was highest with (97.6%) followed by maiwa (94.2%) and the lowest in DM was gero with (93.8%). The CP of manually milled variety is higher compared to mechanized. The CP of maiwa and Gajaga (8.1%) and (8.0%) are higher than gero (5.2%). low CF was recorded at manually milled varieties. The CF of maiwa which is (5.8%) is the highest. Follow by Gero and Gajaga which are (5.2%) and (5.2%) respectively. Higher content of EE was recorded at manually milled varieties. Gero and Gajaga has the higher EE of (3.3%) respectively compared to Maiwa (1.1%). The NFE recorded was higher at mechanized processed varieties. Gajaga has the highest NFE (85.6%), while Gero has the lowest of (70.4%). Higher content of Ash was also recorded at manually milled varieties. Maiwa has the highest Ash (6%) content, followed by Gero (5.6%). Out of six anti-nutritional compound analysed, phytate shows the highest percentage in all the varieties. The content of phytate ranges between (1.66g/100g) and (1.35g/100g) followed by oxalate which also ranges between (1.28g/100g) and (1.15g/100g).

Alkaloid is the most limiting anti-nutritional compounds which ranges between (0.25%) and (0.16%). The result showed higher content of phenol in the mechanically produced brans of Gero and Maiwa, while higher value was recorded in the manually processed bran of Gajaga. The result also showed that phytate is the highest anti-nutritional compounds in millet bran, while alkaloid is the least anti-nutritional compound in millet bran.

Keywords: Millet bran; Proximate; Phytochemical compounds; Processing Methods; Sokoto; Nigeria

Introduction

Millet is one of the most important cereal grain crops produced in many dry areas of the world because of their ability to grow under adverse weather condition and is used as a major food resource alongside wheat, rice, and maize by millions of people, especially those who live in underdeveloped countries of the world. It is a drought resistant crop and can be stored for a long period of time without insect damage [1]; hence it can be important during famine [1]. The millet crop is grown in marginal agricultural lands of the world where the major cereals fail to give substantial yield. It is also the major source of energy and protein for millions of people in Africa, Together with maize, sorghum and coax (Job's tears), millets are classified in the grass subfamily *panicoideae* and belong to the family *gramineae* or *poaceae*. Although there are many varieties of millets, but the four major type are pearl millet (*penisetum glaucum*), fox tail millet (*Setaria italica),* proso millet or white millet *(Panicum miliaceum)* and finger millet *(Eleusine coracaceum)* [2].

Millet bran is a good source of fibre which play important role in livestock nutrition. It helps to maintain the gastro-intestinal tract microbial population and prevent establishment of salmonella and other pathogens in gastro intestinal tract. It also helps to slow down passage of feed in the gastro-intestinal tract thereby allowing better digestion of feed, and enhances higher nitrogen balance. In addition, fibre leads to increase utilization of minerals and reduces the amount of ammonia emission from the laying hen manure. Fibre was also reported to reduce cannibalism in poultry birds.

Jingke, et al. [3] reported that millet bran contain 6.78% CP, 9.07% moisture, 5.65% fat and 2.15% ash, but did not specify type, variety or cultivar of the millet crop. Also, one of the limitations of bran is generally the presence of anti-nutritional (phytochemical) compounds which may hinder utilization of nutrients. The present study aimed at evaluation of the yield, proximate composition and some phytochemical compounds in millet bran from three millets varieties, namely; *Gero, Maiwa* and *Gajaga*, commonly found in Sokoto obtained using the traditional (manual) and modern (mechanized) processing methods.

Materials and Methods

Study Area

This study was conducted in the biochemistry laboratory of Usmanu Danfodiyo University Sokoto. Sokoto state is located in the extreme north-west of Nigeria near to the confluence of the Sokoto river and rima river. Sokoto is located in the sudan savannah zone of Nigeria between latitude 120°N and 13.55°N and longitude 48°E and 645°E [4]. Sokoto has a total land area of 25,973km. It has an average annual temperature of 28.3c (82.9°f) the maximum day time temperature are for most of the year generally under 40°C.

Sample Collection and Preparation

This study was conducted using bran from three millet varieties namely Gero (*pennisetum glaucum*), maiwa (*pennisetum typhoides*) and Gajaga (*pennisetum glaucum*) obtained by manual milling and mechanized milling. Two tiya (about 5kg) grain of each of the millet variety were bought from the market and each was divided into two equal parts, one part was processed manually using mortar and pestle and the other part was processed using milling machine. After milling the brans were obtained.

The bran samples obtained were air dried milled and sieved before laboratory analysis was carried out. Samples for each variety were divided into two, to be for proximate composition analysis (dry matter, crude protein, crude fibre, ether extract, nitrogen free extract and ash) and evaluation of anti-nutritional compounds (phenol, oxalate, saponin, alkaloid, phytate and tannin).

Chemical Analysis

Proximate Composition Analysis

The prepared samples were analyzed for Dry matter (DM), Crude protein (CP), Crude fibre (CF), Nitrogen free extract (NFE), Ether extract (EE) and ash content using the procedure described by association of official analytical chemist [5]. The procedure for evaluation for each proximate component was repeated three times to obtain three readings for each sample.

Anti-Nutritional Compound Evaluation
The anti nutritional compounds evaluated include tannin, oxalate, phenols, phytate, saponins, and alkaloid using appropriate methods as follows:

- Phytate was evaluated using method of Manga.
- Oxalate was evaluated using the method described by Day and Underwood.
- Saponin was evaluated using the method described by the A.O.A.C.
- Tannin was evaluated using the method of Dawra [6].
- Phenol evaluation was carried out using the method of Khanamadi [7].
- Alkaloids evaluation was carried out using method of Sousek, et al. [8].

Data Collection

The three varieties of millets grain (Gero, Maiwa and Gajaga) were sourced from Sokoto central market. About 5kg of each variety was acquired and divided into two each before taken to the millers.

Data Collection and Analysis

Values for proximate composition such as DM, CP, CF, EE, NFE, and Ash were collected from each treatment and value for anti-nutritional factors such as Tannin, Oxalate, Phenol, Saponin, Phytate and Alkaloid were also collected. The data collected was subjected to analysis of variance (ANOVA), using the Gomez and Gomez. Treatment mean that shows significant difference were separated using the Least Significant Difference (LSD) test.

Result and Discussion

Proximate Composition of Millet Bran

Results on proximate analysis for Brans of Gero, Maiwa and Gajaga Millets processed using manual and mechanized methods are presented in table 1.

Treatment	Composition (%)					
	DM	CP	CF	EE	NFE	ASH
Gero						
Manual	87^{d}	5.2^{b}	1.3^{d}	3.3^{a}	70.4^{d}	5.6^{a}
Mechanize	93.8^{c}	2.4^{e}	5.2^{b}	1.8^{b}	83.8^{ab}	2.1^{cd}
Maiwa						
Manual	93.2^{c}	8.1^{a}	2^{c}	1.1^{c}	75.5^{cd}	6.0^{a}
Mechanize	94.2^{c}	4.6^{c}	5.8^{a}	2.1^{b}	78.6^{bc}	2.6^{c}
Gajaga						
Manual	95.8^{b}	8.0^{a}	1.8^{cd}	3.3^{a}	71.1^{c}	4.3^{b}
Mechanize	97.6^{a}	3.0^{d}	5.2^{ab}	1.6^{bc}	85.6^{a}	1.6^{d}
SEM	0.638	0.415	0.272	0.744	2.76	0.143

Table 1: Proximate composition of brans of Gero, Maiwa and Gajaga Millets as influenced by processing methods
The values in the same column with different superscript differ significantly (P< 0.01).

Dry Matter

The results on dry matter (DM) content showed that the DM content of millets bran varied as 87.0 to 97.60%. The mechanical processing method generally produce higher (P<0.01) dry matter values than manual processing method, except for Maiwa where DM content for both processing methods were similar (P>o.o1). The DM content obtained from this study were higher than the 87% DM reported for pearl millet bran by Abakisi, et al. [9].

Crude Protein

The result on crude protein (CP) values varied as 2.4 to 8.1% It was observed that brans from manual processing had higher (P<0.01) CP content (5.2 to 8.1%) compared to the brans from mechanically processed millets (2.4 to 4.6%). However, the CP values obtained from this study are generally lower than 14.3% CP value reported for pearl millet by Abakisi, et al. [9].

Crude Fibre (CF)

The result on crude fibre (CF) showed that the CF content varied as 1.3 to 5.8%. Mechanically processed millet bran generally produced higher (P<0.01) CF value (5.2 to 5.8) than manually processed bran (1.3 to 2.0%). The crude fibre obtained from mechanically processed millet brans were similar or slightly higher than the 5.2% CF value reported by feedipedia (2015) for the pearl millet bran. However, for the manually processed bran were lower than that reported by Feedipedia [10].

Ether Extract (EE)

The result on ether extract (EE) showed that the EE values varied as 1.1 to 3.3%. The manually processed brans generally produce higher (P<0.01) EE values (1.1 to 3.3) except for Maiwa where the mechanical processing method produce higher EE. The EE values obtained from this study were lower than 3.9% EEt bran reported by Feedipedia [10].

Nitrogen Free Extract (NFE)

The result on nitrogen free extract (NFE) showed that the NFE varied as 70.4 to 85.6%. The mechanically processing methods generally produce higher (P<0.01) NFE than manually processed brans (70.4 to 75.5%) The NFE values obtained from mechanical processing method were higher than 76.3% NFE reported for pearl millets by Abakisi, et al. [9]. However, the NFE values obtained from the manual processing method were lower lower than the value reported by Abakisi, et al. [9].

Ash (total mineral)

The result on Ash content showed that the ash values varied as 1.6 to 6.0%. The manually processed brans generally produce higher (P<0.01) ash value than the mechanical processed brans (1.6 to 2.6%). The values for ash content of manually processed millet bran from this study were similar to the ash value of 2.5% reported by Abakisi, et al. [9].

Anti-Nutritional Factors in Brans of Gero, Maiwa and Gajaga Millet as Influenced by Processing Method

Results on Anti-nutritional factors from Brans of Gero, Maiwa and Gajaga Millets as influenced by processing methods are presented in table 2.

Treatment	Composition(mg/100g)					
	Tanin	Saponin	Phytate	Alkaloid	Oxalate	Phenol
Gero						
manual	0.92^{a}	1.1^{e}	1.35^{f}	0.23^{b}	1.15^{e}	0.62^{d}
Mechanized	0.80^{d}	1.1^{e}	1.66^{a}	0.25^{a}	1.12^{f}	0.82^{a}
Maiwa						
Manual	0.82^{c}	1.2^{c}	1.46^{d}	0.18^{d}	1.21^{c}	0.66^{c}
Mechanized	0.77^{e}	1.2^{c}	1.44^{e}	0.16^{e}	1.28^{a}	0.80^{a}
Gajaga						
manual	0.90^{b}	1.3^{a}	1.59^{b}	0.23^{b}	1.24^{b}	0.71^{b}
Mechanized	0.89^{b}	1.3^{b}	1.49^{c}	0.22^{bc}	1.18^{d}	0.65^{c}
SEM	0.082	0.014	0.294	0.0082	0.096	0.0082

Table 2: Anti-nutritional factors in Brans of Gero, Maiwa and Gajaga Millet as influenced by processing method.
The values in the same column with different superscript differ significantly (P<0.001)

Tannin

The result on Tannin content showed that the tannin content from millet bran varied as 0.77 to 0.92mg/100g. The manually processed brans generally produce higher (P<0.01) tannin values (0.82 to 0.92mg/100g) than mechanically processed brans (0.77 to 0.89mg/100g), except for Gajaga where values were similar (P>0.01) for both processing methods. The tannin values obtained from this study were generally lower than 230mg/100g (0.23 g/100g) of millet flour reported by Florence [11].

Saponin

The result on saponin content showed that saponin content from millet bran varied as 1.1 to 1.3mg/100g. The values obtained from both mechanical and manually processed millet bran were similar (P>0.01). The saponin values obtained from this study were lower than

56000mg/100g (5.6%) for soybean grain reported by Richard.K and owusu [12].

Phytate

The result on phytate content showed that phytate content of millet bran varied as 1.35 to 1.66mg/100g. The values obtained from the manually processed brans of Maiwa and Gajaga were higher (P<0.01) than the mechanically processed brans. The value obtained from manually processed bran of Gero were lower (P>0.01) than mechanically processed. The phytate value obtained from this study was lower than 780mg/100g (0.78g/100g) of millet flour reported by Florence [11].

Alkaloid

The result on Alkaloid content showed that alkaloid content from millet bran varied as 0.18 to 0.25mg/100g. The value obtained from manually processed brans of Gero were lower (P<0.01) compared to mechanically processed brans. The mechanically processed brans of Maiwa were lower compared to the manually processed. The values obtained from manual and mechanical proceesed brans of Gajaga were similar (P>0.01) [12-15].

Oxalate

The result on oxalate content showed that oxalate content of millet bran varied as 1.12 to 1.28mg/100g. The manually processed brans of Gero and Gajaga produced higher (P<0.01) values compared to the mechanically processed brans of the two varieties [16-18]. The mechanically processed brans from Maiwa produced higher value compared to manually processed bran.

Phenol

The result on phenol content showed that phenol content of millet bran varied as 0.62 to 0.82mg/100g. The mechanically processed bran showed higher (P<0.01) value in Gero and Maiwa compared to the manually processed. The manual processed millet bran of Maiwa showed lower (p>0.01) value compared to mechanical processed. The phenol content of millet bran obtained from this study is higher compared to 0.33mg/100g phenol reported for pearl millet by Lynda and Lloyd [19-22].

Conclusion and Recommendation

Conclusion

The result of proximate analysis has shown significant differences in DM, CP, NFE, EE, and Ash. (P<0.01). And the result also showed that millet bran is rich in DM, CP, NFE, and CF and it can be used as alternative feed ingredient. Selection of variety and processing method could be made based on the nutrient its being selected for. The anti-nutritional compounds analyzed has also showed significant different (P<0.01) among varieties and processing methods, Selection of Millets bran should also be made based on the variety and processing method with lower anti-nutritional compounds.

Recommendation

If millet bran is selected for DM, CF, and NFE, it should be processed mechanically. But if it is selected for CP, EE, and Ash, it should be processed manually.

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