Nutrients, antinutrients and protein digestibility of two pearl millet varieties grown in Sudan

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Abstract:
Two varieties of pearl millet (Standard and Ugandi) were obtained from Elobeid Research Station and used in this study. Chemical Investigations showed that the varieties contained 1.1%, and 1.3% ash, 1.6% and 1.3% oil, 17.5% and 16.3% protein and 66.9%, 68.5% starch for the two varieties respectively. The anti-nutritional contents of the Standard and Ugandi varieties were found to be 303.7mg/100g and 443.5mg/100g total polyphenols, 0.25% and 0.33% tannin and 942. protein, 93mg/100g, 1076.20 mg 100g phytic acid for each of the two varieties respectively. The in vitro protein digestibility IVPD was 72.7% for Standard variety and 70.4% for Ugandi variety.
Introduction

Bulrush millet (Pennisetum glaucum) also called pearl millet is of the same order of height as maize and sorghum. It is one of the most drought resistant millets and possibly more widely grown than any other crop in tropical areas of very low rainfall (Masefield et al., 1969). In Sudan, pearl millet is grown under rainfed conditions, mainly in western Sudan, also it is grown to certain extent in eastern, central and southern Sudan (Ali et al., 2004).

Millet is a high energy nutritious food, especially recommended for children, convalescents and elderly (FAO, ICRISAT 1996). Among millets, pearl millet is known to contain a higher protein content and better amino acid balance than sorghum. The higher ratio of germ to endosperm is responsible for the higher protein. Tannins affect the growth of animals in three main ways: they have an astringent taste, which affects palatability and decreases feed consumption, they form complexes with proteins and reduce digestibility and they act as enzyme in activators. All these factors result from the interaction of tannins and proteins to form complexes, an interaction that depends primarily on relative proportions of phenol and protein (Van Buren and Robinson, 1969).

Materials and Methods

(1) Material:
The pearl millet (P. glaucum) varieties were obtained from Elobied Research Station; they were harvested in the season 1997 – 1998; the varieties were Standard and Ugandi.

(2) Preparation of the sample:
The grains were cleaned from foreign materials and broken seeds; the cleaned grains were milled in a laboratory mill to pass 0.4 mm screen and stored in polyethylene bags, stored at 4°C for further analysis.

(3) Chemical analysis:
3 – 1 Moisture: Dry matter, Crude fibre and Crude ash were determined according to AOAC (1984) method.
3 – 2 Crude protein determination:
Crude protein was determined according to micro – kejldahl method of AOAC (1975).
3 – 3 Starch determination:
Starch was determined by the method of dispersal in CaCl₂ followed by iodine spectrophotometry (Kerr, 1950).
3 – 4 Total polyphenols determination:
Total polyphenols were determined according to pursson blue spectrophotometric method (Price and Butler, 1977). This method was employed to estimate the total polyphenolic content of sorghum grain.
3 – 5 Tannin content determination:
Quantitative estimation of tannin was carried out using the modified vanillin – HCl reagent method (Price et al., 1978).
3 – 6 Phytic acid determination:
Phytic acid content was determined by the method described by Wheeler and Ferel (1971).
3 – 7 Determination of the in Vitro Protein Digestibility:
In vitro protein digestibility was carried out by the method of Mailiwal (1983) with modification by Monjula and John (1991).

Statistical Analysis
Each determination consisted of the mean of three analyzed samples. The analysis of variance (Snedecor and Chochran, 1987) and the Duncan’s multiple range test (P ≤ 0.05) (Duncan, 1955) were carried out.

Results and Discussion

1- Moisture Content:
The moisture content (Dry matter) of standard and Ugandi varieties were 8.2% and 7.6% respectively and these results are in line with the range reported by Abdalla (1996) who reported a value of 9% and 7.8% for pearl millet varieties grown in USA.

2- Ash Content:
The ash content was found to be 1.1% and 1.3% for standard and Ugandi varieties respectively. These values are higher than the value reported by Khatir (1990) which was 0.8%.

3- Crude Fibre Content:
The crude fibre content of Standard variety was 3.8% and for Ugandi variety is 4.1% . The values are near the value obtained by Abdalla (1996) who reported a value of 4.0% for Kabti genotype pearl millet.

4- Oil Content:
The oil content of pearl millet was found to be 1.6%(for Standard variety) and 1.3%(for Ugandi variety), these values are noticeably smaller than the values reported by Abdalla(1996) which were in the range 2.7 – 7.1% .But are higher than the values 0.57 – 0.90 % reported by Lai and Varriano – Marston and Hoseney (1980) for pearl millet grown in Kansas.

5- Crude Protein Content:
Crude protein contents were 17.5% and 16.3% for Standard and Ugandi varieties respectively. The values are higher than the range of 14.2% to 15.5% which is obtained by Khatir (1990).

6- Starch Content:-
Starch content was 66.9% for Standard variety and 68.5% for Ugandi variety. These results are in agree with the range reported by Abdalla (1996) which was 58 – 70%. Also the values are less than the value obtained by Almeida – Domenguez et al., (1993) which was 70.8%.

Antinutrient Contents:
The anti nutrient contents of the two varieties is shown in table (2).

(1) Polyphenols:
Total polyphenols was found to be 303.7 mg / 100 g for Standard variety and 443.5 mg / 100g for Ugandi variety. The results were lower than the value 761 mg / 100mg obtained by Kheterpaul and Chauhan (1990) and higher than the value obtained...
by Dahiya and Kapoor (1994) which was 168.5 mg/100g.

(2) Tannins:

Tannin content was found to be 0.25% and 0.33% for the Standard and Ugandi varieties respectively. These values are very small compared to the value obtained by Ikemefuna (1994) who reported 30.3% tannin content for whole pearl millet.

(3) Phytic Acid Content:

Phytic acid content was found to be 94.3 mg/100g for Standard variety and 1076 mg/100g for Ugandi variety. These results are higher than the values 246 mg/100g, 532 mg/100g and 441 mg/100g obtained for three pearl millet genotypes reported by Abdalla (1996). The value 990 mg/100g which is obtained by Kheterpaul and Chauhan (1990) is near to the value obtained for the Standard variety.

In Vitro Protein Digestibility (IVPD):

The in vitro protein digestibility of the whole pearl millet flour was found to be 72.7% for Standard variety and 70.4% for Ugandi variety (Table 3). These results are higher than the value reported by Kheterpaul and Chauhan (1990) for whole pearl millet which was 51%. It’s observed that the variety of the higher polyphenols, tannin and phytic acid contents had an IVPD of lower magnitude. The observation is true for other cereals, as reported by Hassan and ElTinay (1994) who reported values of 73.6% and 70.7% IVPD for low tannin cultivar and a high tannin cultivar of sorghum respectively.

Conclusions and Recommendation:

The analysis of the two pearl millet varieties: Standard and Ugandi showed that the first one had the highest protein, moisture, oil content and the IVPD. While the Ugandi variety had highest amounts of ash, fibre, starch, polyphenols, tannins and phytic acid content. It’s observed that there is a negative relationship between tannin, polyphenols and phytic acid, and the IVPD.

Recommendations:

1- Pearl millet is a palatable cereal crop in Sudan used in Kisra, aseda or balila and some times it’s used for medical purposes, so more investigations of Sudanese pearl millet are needed for better utilization, on factors responsible for rapid deterioration of the flour also.
2- More investigations are needed for processes which could improve the nutritive value and proved to decrease the levels of the antinutrients of the crop e.g.: fermentation, dehulling, soaking, autoclaving, germination, etc. etc.
3- When consumed fermentation and/or dehulling is found to increase the IVPD and the nutritive value while it decreases the level of the anti nutrients (Elhag et al., 2002), So we should encourage people to use domestic processing when consuming pearl millet.
References:


Table (1) The Nutritive value of two varieties of pearl millet grown in Sudan

<table>
<thead>
<tr>
<th>Chemical composition</th>
<th>Standard Variety</th>
<th>Ugandi Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>8.2 (±0.21)c</td>
<td>7.6 (±0.21)c</td>
</tr>
<tr>
<td>Ash</td>
<td>1.1 (±0.21)f</td>
<td>1.3 (±0.17)c</td>
</tr>
<tr>
<td>Oil</td>
<td>1.6 (±0.37)f</td>
<td>1.3 (±0.11)e</td>
</tr>
<tr>
<td>Fibre</td>
<td>3.8 (±0.07)d</td>
<td>4.1 (±0.04)f</td>
</tr>
<tr>
<td>Protein</td>
<td>17.5 (±0.17)b</td>
<td>61.3 (±0.17)b</td>
</tr>
<tr>
<td>Strach</td>
<td>66.9 (±0.05)a</td>
<td>68.5 (±0.30)a</td>
</tr>
</tbody>
</table>

Values are the means of triplicate determinations ± S.D.

Table (2) The anti nutrient factors of two varieties of pearl millet grown in Sudan

<table>
<thead>
<tr>
<th>Antinutrient</th>
<th>Standard</th>
<th>Ugandi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total poly phenols (mg/100g)</td>
<td>303.7 (±0.01)b</td>
<td>443.5 (±0.02)b</td>
</tr>
<tr>
<td>Tannins (%)</td>
<td>0.25 (±0.001)c</td>
<td>0.33 (±0.001)c</td>
</tr>
<tr>
<td>Phyticacid (mg/100g)</td>
<td>942.93(±0.02)</td>
<td>1076.20 (±0.16)</td>
</tr>
</tbody>
</table>

Values are the means of triplicate determinations ± S.D.
Table (3) The in vitro protein digestibility IVPD of two verities of pearl millet (%)

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Ugandi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>72.7(±0.15)</td>
<td>70.4(±0.25)</td>
</tr>
</tbody>
</table>

Values are the means of triplicate determinations ± S.D.

المستخلص:
أُجريت هذه الدراسة على صنفين من الدخن اللؤلؤي تم إحضارهما من محطة أبحاث الأبيض بغرض معرفة كمية المغذيات، مضادات التغذية وقابلية هضم البروتين، والعصبيتين هما: Standard and Ugandi؛ 17.5, نسبة البروتين 1.3 %، نسبة الدهن 1.6 %، نسبة البروتين 17.5 %، نسبة النشا 16.3 %، نسبة النيتر الصلب 70.4 %، نسبة النشا 66.9 % لكل من الصنفين على التوالي. أما كمية مضادات التغذية فقد كانت كالتالي: متعدد الفينول 303.7 مجم / 100 جم، 443.5 مجم / 100 جم، ونسبة التانين 0.25 %، 0.33 %، بينما كانت نسبة حمض الفايتيك 492.9 مجم / 100 جم، 1076.2 مجم / 100 جم لكل من الصنفين على التوالي. أما قابلية هضم البروتين فقد كانت 72.7 % للصنف Ugandi و 70.4 % للصنف Standard.  

ينتشر الصنف القباسي على تراكيز أعلى من البروتين الرطوبة والدهون كما كانت قابلية هضم البروتين أعلى مقارنة بالصنف الثاني. احتوى الصنف الثاني على نسبة رماد، الياف، نشا، ومتعدد الفينول، التانين، وحامض فايتيك أعلى مقارنة بالصنف الأول.