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The potential of fonio (Digitaria exilis, Stapf) as feed for monogastrics in Ghana

Thirteen genotypes of fonio (Digitaria exilis, Stapf) assembled from the Saboba-Chereponi and Zabzugu-Tatale Districts in the Northern Region of Ghana were evaluated for the amount of crude protein and minerals in the polished grains. (with the permission of Livestock Research for Rural Development).

Thirteen genotypes of fonio (
Digitaria exilis,
Stapf) assembled from the Saboba-Chereponi and Zabzugu-Tatale Districts in the Northern Region of Ghana were evaluated for the amount of crude protein and minerals in the polished grains. The fonio grains of the 13 genotypes, as cereals, had high crude protein content reaching 6-8% in most cases. The amounts of phosphorus, potassium and trace minerals (Cu, Fe, Mn and Zn) were also high making fonio grains a reliable material for formulating poultry and pig feed to meet the nutrient specifications of such feed. Field evaluation of the use of unpolished fonio grain to feed monogastrics in the growing areas of the crop is recommended.

Keywords:
Crude protein, fonio, Ghana, minerals, monogastrics

Introduction

Digitaria exilis
(Stapf) is a cereal indigenous to the savannah regions of West Africa (Dalziel 1937; Purseglove 1988). Its common names are acha, fonio and hungry rice among others. In Ghana, fonio is cultivated mostly in areas east of Yendi, specifically in the Saboba-Chereponi and Zabzugu-Tatali Districts of the Northern Region by the Anufus a.k.a. Chokosis and Konkomba people who call it
nvoni
and
ekpui
respectively. Large fonio production for human consumption is however limited by the drudgery in post-harvest handling especially polishing of the small grains. This tends to become an advantage to exploit the production of the crop as a livestock feed where there will be no need to polish the grains. Both unpolished grain and straw can be used to feed farm animals satisfactorily.

Digitaria exilis
belongs to the family
graminae
and the tribe
poaceae
. It closely resembles the wild
Digitaria longiflora
(Retz) (Dalziel 1937; Purseglove 1988) and grows under varying conditions from poor dry upland soils to hydromorphic valleys suitable for rice production (National Research Council 1996). The small grain has promising unique nutritional qualities. Nutrition experts have acknowledged it as exceptional. Its seed has a high protein content of about 8.7% and in some black fonio samples, may be up to 11.8% (Carbiener et al 1960). Fonio grains are rich in methionine, cystine and other

amino acids vital to human health but deficient in today's major cereals: wheat, rice, maize, sorghum, barley and rye, some of which form the bulk of feed for monogastrics.

Here we report the evaluation of the nutritional potential of 13 fonio accessions assembled from the major growing areas in Ghana.

Materials and methods

Eleven fonio accessions were collected from the Saboba-Chereponi District in the Northern Region of Ghana in 2000. These genotypes were rejuvenated to multiply the seed along side two checks (the most grown cultivars -
Yadema and Nomba
) that were collected from the same area in 1998.

Each of the 13 genotypes was planted in 4 replications during the 2000-cropping season at the Savanna Agricultural Research Institute at Nyankpala, Ghana (Alt 183m, Lat. 9° 25" N and Long. 0°58" W). Fonio seeds were drilled on rows, 50cm apart, at a rate of 5 kg ha-1. Plot sizes of 2 × 2m were used.

Samples of the polished grains were analysed for %N, total P and K, Zn, Mn, Fe and Cu. The values obtained for %N were multiplied by a conversion factor of 6.25 to obtain the crude protein content in the grains.

The results were compared with typical nutrient specifications for the formulation of feed for poultry and pigs.

Results and discussion

Grain yield of the fonio genotypes obtained ranged from 1.9 to 2.4 t ha-1. This is comparable to some maize yields obtained by farmers. Indeed the annual average maize yields recorded in the Northern Region of Ghana from 1991-2000 ranged from 0.80 to 1.44 t ha-1 (unpublished MoFA-NR production figures 1991-2000) and nationally from 0.73 to 1.03 t ha-1 (MoFA, 2001).

Fonio contains greater amounts of most of the essential amino acids than the popular full season maize, Okomasa. Not even the quality protein maize (QPM) variety Obatanpa come close to it. In fact Obatanpa contains greater amounts of only lysine than fonio as shown in Table 1.

Table 1.
Essential amino acid content of fonio compared to Obatanpa and Okomasa maize on percentage dry matter basis

Amino Acid	*** Fonio**	****Okomasa**	****Obatanpa (QPM)**

Threonine	0.37	0.24	0.34
Cystine	0.25	0.19	0.26
Valine	0.55	0.33	0.48
Methionine	0.45	0.17	0.15
Isoleucine	0.40	0.23	0.30
Leucine	1.05	0.77	0.88
Phenylalanine	0.57	0.31	0.39

Lysine	0.25	0.23	0.36
Tryptophan	1.60	0.06	0.10
Tyrosine	0.35	-	-

*Sources: *National Research Council 1996*

***Ghana Grains Development Project 1993*

The amount of crude protein, phosphorus and potassium in polished grains of the 13 cultivars of fonio is presented in Table 2 together with typical specifications of these nutrients for the formulation of feed for poultry and pigs. The term poultry used here embraces fowls, ducks and turkeys.

Table 2.
Crude protein, phosphorus and potassium in polished fonio grains compared with their requirements for feed formulation for some monogastrics

Genotypes	Crude Protein, %	Phosphorus, %	Potassium, %
Yadema	3.75	0.14	0.09
Nomba	3.75	0.21	0.10

HR 3	6.38	0.10	0.08
HR 4	7.00	0.13	0.06
HR 5	6.50	0.20	0.08
HR 6	7.31	0.18	0.09
HR 7	7.75	0.24	0.12
HR 8	6.69	0.13	0.14
HR 9	5.94	0.24	0.12
HR 10	6.25	0.13	0.09
HR 11	5.88	0.32	0.11
HR 12	7.13	0.27	0.14
HR 13	5.88	0.15	0.06
*POULTRY	15-21	0.55-0.75	0.0-12.5
*PIGS	12-18	0.50-0.70	0.0-10.0
Source of data: Parr et al 1988			

Crude protein in the fonio genotypes ranged from 3.75-7.75% (Table 2) indicating that the unpolished grains may contain more as reported by Carbienier et al 1960. This makes fonio grains capable of supplying about a third to one-half of the typical crude protein requirements in feed of monogastrics.

Fonio grain phosphorus reserves are also quite high as the grains can provide much of the phosphorus requirements (from about a quarter to about a half) in animal diets. The amount of ash (potassium) in fonio grains although not that high, can meet some of the requirements needed for the formulation of poultry and pig diets.

The genotypes of fonio assembled turned out to be also rich in trace minerals as shown in Table 3. From the results, fonio grains can provide adequately the trace minerals needs of monogastrics.

Table 3.
Trace minerals in polished fonio grains and their requirements for feed formulation for some monogastrics, mg kg-1

Genotypes	**Zn**	**Mn**	**Fe**	**Cu**
Yadema	40.0	160	2387	83
Nomba	30.0	183	3132	127
HR 3	26.7	160	1620	137

HR 4	20.0	143	7650	123
HR 5	26.7	147	2307	130
HR 6	30.0	140	997	83
HR 7	46.7	137	705	123
HR 8	33.3	117	2117	90
HR 9	50.0	160	2212	137
HR 10	43.3	153	2430	147
HR 11	53.3	130	4827	123
HR 12	43.3	160	1540	177
HR 13	43.3	183	4025	157
*POULTRY	50-75	30-100	40	10
*PIGS	30	10	40	5-125

**Source of data: Parr et al 1988*

This potential has to be exploited to improve the production of these animals. Pigs and poultry are animals that play very important role in the socio-cultural settings of the Konkombas and fonio is extensively grown in that area so it is an area where field trials can be undertaken to substantiate the benefits of using unpolished fonio grains to supplement the nutrient requirements of these animals.

Conclusions

- Fonio grain with its rich amounts of amino acids present in the high protein component for a cereal will be a very good feed source for poultry and pigs. The macro elements, phosphorous and potassium levels in fonio grains can be relied upon to meet the specifications for the formulation of animal diets. Fonio grains can provide adequately the trace elements (Zn, Cu, Mn and Fe) needs of monogastrics.
- Field evaluation of the potential of unpolished fonio grains to supplement the protein and mineral requirements in the feed of farm animals must be undertaken in the fonio growing areas. The anticipated positive response in its use for feeding animals will boost the production levels of the crop.

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