Effect of Different Malting Periods on Anti-nutritional Factors of Three Locally Grown Sorghum Varieties in Bauchi State, Nigeria

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Abstract
An experiment was conducted to assess the effect of different sprouting periods on antinutritional factors of different local sorghum varieties. The sorghum varieties were malted for forty eight hours, seventy two hours and ninety two hours. The germination periods were analyzed by simple percentages. Results showed that in kaura sorghum, tannin decrease varied between (96.33- 96.92%), the phytic acid decrease varied between (80.29- 82.48%) and the oxalate decrease varied between (86.67%- 90.48%). In jardawa tannin decrease varied between (43.00%-90.48%), phytic acid ranged between (22.60%-60.31%) and oxalate varied between (1.77-35.28%). in farfara sorghum tannin decrease varied between (3.64-61.82%), phytic acid varied between (4.00-8.00%) and oxalate ranged between (00.00-17.39%). There is a wide variation in antinutritional factors of sorghum; selection of local sorghum varieties for antinutritional factors can be carried out during feed formulation. The result of this study showed that antinutritional factors of sorghum can be reduced by increasing the duration of malting time and this can enhanced the nutritive value of different sorghum varieties.

Keywords: Malting, sorghum, varieties, antinutritional factors.

Introduction

The poultry industry has suffered more than any other livestock industry as a result of inadequate supply and high cost of feeds (Adegbola, 1998). Feeding accounts for 75-85% of total cost for poultry production (Sanni and Ogundipe, 1985) and cereal grains constitute the major sources of energy in poultry diets in the tropics (Oluyemi and Roberts, 2000). However, maize has remained the chief energy source in compounded diets and constitutes about 50% of poultry ration (Ajaja *et al*., 2002). Pressure on maize, wheat and recently cassava has been on the increase worldwide with emphasis being placed on export, industrial and other diversified use mostly in flour based foods and ethanol production as an alternative source of fuel (Egbunike and Achibang, 2002). Field observations in Nigeria revealed the inclusion of sorghum in poultry ration reduce the cost of feeding and provide an alternative (Abubakar et al., 2006; Etuk and Ukaejiofo, 2007). *Sorghum bicolor* (L) Moench is widely grown in the semi-arid and arid savannah regions of Nigeria. Maunder (2002) reported that sorghum is a traditional crop of much of Africa and Asia and an introduced and hybridized crop in the western hemisphere. It benefits from an ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereals. In terms of the nutritive value, cost and availability, sorghum grain is the next alternative to maize in poultry feed (Subramanian and Metta, 2000). Several varieties of sorghum have been developed and introduced in Nigeria (IAR, 1999). Sorghum constitutes a significant source of protein, energy and minerals for millions of poor people in Africa and Asia (Mohammed *et al*., 2011). The grain is composed of three main parts: seed coat (pericarp-testa), germ (embryo) and endosperm (storage tissue). The seed coat contains copious amount of polyphenolic compounds which combine with other flavonoids (anthocyanins, anthocyanidins, etc.,) to give it varying colours (Okrah, 2008). The germ fraction of sorghum is rich in minerals (ash), protein and lipids as well as B-group vitamins: thiamine, niacin, and riboflavin which also occur in the aleurone layer (Pomeranz, 1987; Palmer *et al.,* 1989) while the endosperm consists mainly of starch granules, storage proteins and cell-wall materials (Ogbonna, 2011).

Malting is one of the methods used in elimination of various anti-nutritional factors present in foods. It is a natural process in which dormant but viable seeds are induced to start growing into seedlings (Echendu *et al*., 2009). This is the process by which amylase degrade starches into dextrin and maltose. Malting of seed is characterized by a changing array of enzymatic activities. Some of these activities increase dramatically from an initially low or even undetected state to a moderate level. Later these activities then decline to an activity lower than initially present. Another group of enzyme activities are found in dry seed at an intermediate level which remain constant throughout germination (Nnanna and Phillips, 1988). The enzymes convert the stored foods such as insoluble carbohydrates and proteins to soluble components (Enwere, 1998). Nout and Ngoddy (1997) reported that sprouting/malting of seeds triggers the enzyme systems that cause breakdown of complex macromolecules of proteins, carbohydrates and lipids into simpler forms that are much easily assimilated. Proteins are broken down to peptides and amino acids by protease activity. Nitrogen is transferred to developing axis, carbohydrate to simpler sugars by amylase, phytic acid to inositol and phosphoric by phytase and breakdown of tannin-protein enzyme-mineral complexes.

Sorghum is processed into a variety of traditional foods including fermented and non-fermented products such as unleavened bread, porridges, cookies, cakes, cereal extracts, malted alcoholic and non-alcoholic beverages (Rooney and Serna-Saldivar, 1982). Despite an impressive array of nutrients in sorghum grain, sorghum-based foods have continued to be nutritionally deficient and organoleptically inferior. This is largely due to the presence of anti-nutritional factors (ANF) such as tannin, phytic acid, oxalate, polyphenol and trypsin inhibitors which bind these food ingredients into complexes making them unavailable for animals and human nutrition (Gilani *et al.,* 2005; Idris *et al.,* 2007). For instance, the presence of these anti-nutritional factors limits the digestibility of proteins and carbohydrates by inhibiting their respective proteolytic and amylolytic enzymes (Mohammed *et al.,* 2011). Tannins are water–soluble phenolic compounds that have the ability to bind or precipitate proteins from aqueous solutions. They bind with the proline rich storage proteins of sorghum and inhibit their digestibility. The digestibility is decreased by tannins binding to either digestive enzymes or to the proteins themselves (Butler and Rogler, 1992).The anti-nutritional effect of tannins include diminished growth rate, bioavailability of mineral elements and decreased feed efficiency in rats, swine, poultry and ruminants. Tannins from sorghum reduce digestibility and efficiency of utilization of absorbed minerals nutrition form 3-15%. Phytic acid (myoinositol hexaphosphate), present in most plant materials as phytate salt, is the main phosphorus store in mature seeds. Its association with proteins chelates metal ions (Alemu, 2009) to form protein-mineral-phytate complexes which are highly insoluble at the physiological pH of human intestine (Sandberg and Andlid, 2002). Several methods have been generally adopted to improve the nutritional and organoleptic qualities of cereal-based foods. Malting is a biotechnological technique which involves the controlled germination of a cereal grain which aims at activating enzyme systems that catalyze the hydrolysis of polymerized reserved food materials, notably, proteins, starches and cell-wall substances, thus, extracting fermentable materials (Ogbonna, 2011,). In this paper, the effect of malting periods on the anti-nutritional factors of sorghum grain is reported.

Materials and methods

Experimental site

Katagum local government is situated on the northern part of Bauchi state, Nigeria. It is located between latitudes 11^0 42' and 11^0 40^0 and longitude 10^0 31' and 10^0 11' east (MapXL Inc., 2009). The climate of the study area is controlled by the inter-tropical convergent zone (ITCZ) which is marked by the rainy and dry season. The major climate elements that influence the climate of the study area and affecting the farming system are temperature and precipitation (rainfall), the annual temperature ranged between $22\text{-}33^0$ C from April to May (Bashir *et al*., 2001). The mean annual rainfall ranged between 615.6-985mm with peak between July-Augusts. The study area is in the Sudan savanna, the vegetation is greatly determined by the nature of the soil.

Sources and processing of feed ingredients

The three sorghum varieties are purchased in Azare Central Market. The collected seeds were cleaned by winnowing and hand picking of stones and debris. The three sorghum parameters were soaked in water for 24 hours and spread on jute bags and covered with the same materials and water at intervals. The sprouted sorghum varieties were sprouted at 48 hours, 72 hours and 92 hours. The samples were washed and sun dried for three days. They were taken to biochemistry laboratory of National Veterinary Research Institute Jos were the samples were analyze for antinutritional factors. The method used for phytate analysis was described by AOAC (1990). The oxalate content of different sorghum varieties were determined using the method described by AOAC (1990). The method of estimation of tannin content of different sorghum varieties were according to the standard method described by Negi (1980). The data generated were subjected to percentages.

Results and discussion

The unprocessed kaura sorghum contains 6.81mg/100g of tannin, 1.37mg/100g of phytic acid and 2.10mg/100g of oxalate respectively (Table 1). Malting of kaura sorghum for 48 hours reduced it to 0.25mg of tannin (96.33%), 0.27mg of phytate acid (80.29%) and0.28mg oxalate (86.67%)(Table 1). subjecting kaura sorghum to 48hours depressed most of the tannin factors. This finding is in line with the findings of Talha *et al*., 2008 who reported that 70% of the tannin in sorghum will be depleted during 3 days sprouting and 100% tannin will be removed if sorghum varieties are sprouted for 7 days. Sprouting kaura sorghum for 78 hours reduced the tannin content to 96.48% and sprouting it for 92 hours reduces the tannin contents for (96.48%). The higher the sprouting time the better the efficiency of tannin reduction. In red sorghum which is very high in tannin 85.27mg/100g the reduction as result of sprouting time is less compared to kaura variety, at 92 hours it reduces to (65.52%) and the same trend is observed in the farfara variety in which reduction was reduced to (61.82%). Red sorghum contains highest amount of tannin and provide more resistance to tannin reduction as a result of malting. Reduction in tannin is brought about by leaching as reported by (Sandberg, 2002; Ugwu and Oranye, 2006). The phytic acid level of unprocessed kaura sorghum 1.37mg/100g, 92.60mg/100g in red sorghum and 125mg/100g in Farfara sorghum (Table 1). The phytic acid reduction followed the same trend with tannin, the higher the sprouting time the better the efficiency of phytate reduction. The reduction of phytate is by enzyme phytase which degrade phytate into inorganic phosphorus and myo inositol and its intermediate forms (Idris *et al*., 2005). The oxalate content of unprocessed kaura sorghum was 2.10mg/100g, 97.31mg/100g for red sorghum and 115mg/100g (Table 1). The higher the sprouting time the more effective the reduction of oxalate (Ogbanna, 2012). The reduction in oxalate is brought by calcium released from oxalate complexes and iron from protein-tannin complexes (Melaku *et al*., 2005).

Conclusion: There is a wide variation in antinutritional factors of sorghum; selection of local sorghum varieties for antinutritional factors can be carried out during feed formulation. The result of this study showed that antinutritional factors of sorghum can be reduced by increasing the duration of malting time and this can enhanced the nutritive value of different sorghum varieties.

Table 1: Effect of malting periods on antinutritional factors of three local sorghum varieties

	Tannin	Phytic acid	Oxalate
Unprocessed kaura sorghum	**6.81 mg/100g**	**1.37 mg/100g**	**2.10 mg/100g**
Sprouted for 48 hours	0.25	0.27	0.28
Percentage decrease (%)	96.33	80.29	86.67
Sprouted for 72 hours	0.24	0.25	0.21
Percentage decrease (%)	96.48	81.75	90.00
Sprouted for 92 hours	0.21	0.24	0.20
Percentage decrease (%)	96.92	82.48	90.48
Unprocessed jardawa sorghum	**85.27**	**92.60**	**97.31**
Sprouted for 48 hours	48.60	71.67	95.59
Percentage decrease (%)	43.00	22.60	1.77
Sprouted for 72 hours	38.80	61.86	93.59
Percentage decrease (%)	54.50	33.19	3.82
Sprouted for 92 hours	31.96	36.75	62.98
Percentage decrease (%)	62.52	60.31	35.28
Unprocessed Farfara sorghum	**275.00**	**125.00**	**115.00**
Sprouted for 48 hours	265.00	120.00	115.00
Percentage decrease (%)	3.64	4.00	00.00
Sprouted for 72 hours	200.00	120.00	100.00
Percentage decrease (%)	27.27	4.00	13.05
Sprouted for 92 hours	105.00	115.00	95.00
Percentage decrease (%)	61.82	8.00	17.39

*Means of three determinations

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