PROXIMATE COMPOSITION AND PHYTOCHEMICAL SCREENING OF SPENT SORGHUM RESIDUE - CASSAVA PEEL (SSR-CP) COMPOSITE MEAL

Abah, L.

Department of Animal Production, Joseph Sarwaun Tarka University, P.M.B. 2373, Makurdi, Benue State, Nigeria.

ABSTRACT

A study was conducted to evaluate the proximate chemical composition and anti-nutrients of spent sorghum residue-cassava peel (SSR-CP) composite meal.Wastes of spent sorghum residues and cassava peels are noticed in burukutu joints and garri/cassava chips processing areas respectively, whereas, reports have it that they have individually been used comparatively to replace maize. Spent sorghum residue and cassava peel were mixed in a ration of 1:8 to give crude protein of approximately 9% (similar to that of maize) which it seek to replace. The dry matter, crude protein, crude fibre, ether extract, ash, Nitrogen free extract and Metabolizable energy (Kcal/kg) values are 88.84, 8.37, 8.85, 1.37, 15.44, 54.81, 2435.65 Kcal/kg and anti-nutrient result of Tannin, Saponin, Alkaloids, Flavonoid, Phenol, Hydrocyanide, Oxalate and Phytate values are 16.00g/100g, 1.50g/100g, 10.00mg/100g, 1.83mg/100g, 0.68mg/100g, 1.08mg/100g, 213.7mg/100g, 92.80mg/100g respectively. A ratio of 1:8 of Spent Sorghum Residue (SSR) and Cassava Peel (CP) would appear to give a close enough crude protein to maize. Therefore, the findings of this study will be beneficial to farmers as it will provides improved simple and cheap method of replacing maize.

KEYWORDS

Proximate Composition, Spent Sorghum Residue-Cassava Peel Composite Meal, Anti-nutrients.

1. INTRODUCTION

Spent sorghum residues can also be called *burukutu*s pent grain are by-products obtained from the processing of sorghum to produce “Burukutu”, a local beer. It is abundant all the year round in cities and villages where local beer is being made [1]. Tannins are anti-nutritional factors in sorghum as they bind with proteins, precipitate them and make them unavailable during digestion [2]. The young shoot and newly sprouted seeds also contain dhurrin, a cyanogenic glycoside which on hydrolysis yield hydrogen cyanide (HCN), [3,4,5]. Some varieties of sorghum have phenols concentrated in the outer layers of the kernel which serves as natural source of antioxidants for foods [6]. The effects of tannins in sorghum tend to affect animal’s feed intake, feed digestibility and efficiency of production. [7] reported that, increasing the tannin level in diet linearly depressed weight gains of turkeys and increase their feed conversion efficiencies. According to [8], Brown sorghum is higher in tannin content when compared to white sorghum and maize. According to [9], tannins are probably responsible for retarding the degradation of proteins in the high-tannin sorghum cultivars. According to [10], there is sufficient evidence that, tannins decrease the utilization of proteins, carbohydrate, amino acid, minerals and vitamins. It is thought that, tannins bind proteins [8], including digestive enzymes. Thus, protein digestibility is decrease by tannins [11]. The problem of tannins can be reduced by soaking, drying, ensiling, pelleting, grinding and fermentation as effective ways in reducing cyanogenic glycosides [12,13,14,15].

Cassava peel is the outer covering (first layer being brownish red, followed by a whitish mesoderm) of the tuber, which is usually removed manually with sharp knife, with little or no pulp in the process of turning the raw pulp into various human foods such as *garri*, *fufu*, *lafun*, and *tapioca* among others in many tropical countries [16] and utilization of cassava as a primary feed ingredient in livestock feeding programs has been limited due to presence of toxic cyanogenic compounds in various fractions and cultivars, high fibre and ash levels in peels [17] and deficiencies of specific nutrients other than energy, amino acids (particularly Methionie and Tryptophan), fatty acids, minerals, and vitamins (reviewed in [18]). High moisture content, concomitant rapid rates of deterioration in wet fractions and dustiness of dried materials are also practical considerations in transport, storage, handling and utilization [19,20]. As such, cassava peels and tubers should be processed rapidly following harvest to reduce cyanogenic potential and to preserve nutritive quality through drying, soaking, fermentation and/or combinations of these treatments [21]. The peels contain higher levels of cyanogenic glucosides, two major cyanogenic glucosides, linamarin and Lotaustralin than the root meal [22,23]. However, sun drying for seven sunny days and crushing reduces the content of these toxic factors to safety margins [14].

Because cassava peel is a cheap source of energy for farm animals, it should be fortified with additional protein source due to its low protein level relative to that of maize, as such there is paucity of information on the possible combination of spent sorghum residue and cassava peels and as a composite feedstuffs. Hence, this study is aimed at determining the proximate composition and anti-nutrients of Spent Sorghum Residue – Cassava Peel Composite Meal.

2. Materials and Methods

2.1. Experimental Site

The proximate composition was conducted at the Animal Nutrition Laboratory of the Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria while the phytochemical screening was carried out at the Chemistry Laboratory of the Benue State University, Makurdi, Benue State, Nigeria. Makurdi is located on latitude 17°14"North and longitude 8° 31"East and 90 m above sea level. Makurdi has a tropical climate with distinct wet and dry seasons. The mean temperature ranges from 15.6°C in December/January to 38°C in February/March with an annual average of 27.5° C [24]. The area has an annual rainfall between 6 - 8 months (March - October) which ranged from 508 to 1016 mm with a minimum temperature range of 24.20 ± 1.4^{0}C and maximum temperature range of 36.33 ± 3.70^0 C. The relative humidity ranges between 39.50 ± 2.20% and 64.00 ± 4.80 % [24].

2.2. Sources of Experimental Diet

Spent sorghum residue were collected from *burukutu* (local beer) production sites within Makurdi metropolis, they were sun dried for seven rain free/sunny days and crushed (so it doesn't form moths and lead to losses/damage during storage). Cassava peels were collected from *garri*/cassava chips processing locations in Idiri-Okpoga, Okpokwu Local Government Area of Benue State, washed and sun dried for seven rain free/sunny days and crushed. They were both crushed with a hammer mill to produce finely ground spent sorghum residue – cassava peel composite meal.

2.3. Chemical Analysis

Sample of the spent sorghum residue – cassava peel composite meal was then subjected to proximate analysis according to [25] and the combined spent sorghum residue and cassava peels as a composite meal was used in a ratio 1:8 to bring the crude protein relative/close to that of maize (a conventional feedstuff) which it seeks to replace.

2. RESULT AND DISCUSSION

3.1. Proximate Composition of SSR-CP Composite Meal

Variations exist in the use of agro industrial byproducts and the reason(s) for these differences could be: the processing method used for the brewer's grain and cassava peels, the method of chemical analysis used, the types of grains (sorghum, barely, corn, wheat and rice etc) and cassava used, the type of processing of *garri*/cassava chips that produced the cassava peels and brewery that produced the brewer's spent grain, the duration of fermentation of the grains and cassava before brewer's spent grain and cassava peel production, the type of fermentation to which the brewer's grain and cassava was subjected and environmental and climatic influence on brewer's spent grain and cassava peel production, variety and stage of maturity, soil composition, vegetation, quality difference, storage periods and topography etc.

The result of proximate composition of SSR-CP composite meal is shown in Table 1. The proximate composition result of SSR-CP is shown on Table 1. The Dry Matter (DM) (88.84 %) is lower than 91.80 % reported by [26], 95.40 % by [27] and similar to [28] who reported 90.10 %, 89.00 % reported by [29] for maize. However, the DM in spent sorghum residue 93.50 % and 93.54 % reported by [30] and [31] respectively is higher than the reported SSR-CP composite meal value in this study but the value in this study is higher than 86.20 % reported by [32] 86.30 % reported by [33] and similar to 90.56 % reported by [31] for cassava peels. This could be as a result of the processing method used.

The Crude Protein (CP) of 8.37 % recorded in this study is less than 9.25 % and 9.65 % reported by [34] and [28] respectively but almost similar to 8.8 % reported by [26] and 9 % reported by [35] for maize. However, the CP is lower than 31.60 % by [30], 25.64 % by [36], 24.07 % by [31] for spent sorghum

Table 1: Proximate Composition of SSR-CP Composite Meal

PARAMETERS	% COMPOSITION
Dry Matter	88.84
Crude Protein	8.37
Ether Extract	1.37
Ash	15.44
Crude Fibre	8.85
Nitrogen Free Extract	54.81
Metabolizable Energy (kcal/kg)	2435.65

residue and higher than 5.10 % by [32], 6.30 % by [33] except for [31] who reported 18.98 % for cassava peels. This indicates that the crude protein in SSR-CP compares favourably to that of maize in the conventional energy feedstuff.

Crude Fibre (CF) of 8.85 % is higher than 1.99 % posited by [28], 1.90 % by [29], 5.50 % by [27] for maize but close to 7.80 % by [30], 8.20 % by [31]for spent sorghum residue, 8.05 % by [31] for cassava peels and less than 14.76 % by [36] for dried spent sorghum residue and 16.70 % by [32], 20.22 % by [33], 19.72 % by [37]for cassava peels. The CF of the test ingredient (8.85 %) could help increase the feed intake of the rabbit as well as caecum motility.

The Ether Extract (EE) of 1.37 % is less than 3.98 % reported by [28], 4.10 % and 4.80 % posited by [26] and [29] for maize. However, the reported EE of 13.73 % by [30], 6.85 % by [36] for spent sorghum residues, 4.50 % and 5.19 % by [31] for burukutu wastes and cassava peels respectively and 5.02 % by [37] for cassava peels is higher than the value in this study but the value in this study can be compared with 1.2 % by [32] and 2.32 % by [33] for cassava peels.

The Ash content (15.44 %) in this study is higher than 1.00 % by [26] and [27], 9.47 % by [28] and 1.30 % by [29] for maize. However, 6.77 % posited by [33], 6.44 % by [38] for cassava peels and 5.00 % and 6.64 % reported by [31] for burukutu wastes and cassava peels respectively are lower than the value in this study but compares with 16.00 % reported by [30]. The difference in the ash content by different authors could be as a result of the residue in processing of these materials.

Nitrogen Free Extract (NFE) value (54.81 %) is lower than reports of 73.46 % by [28], 81.40 % by [29] and 79.35 % by [27] for maize. Although, 64.39 % reported by [33] and 65.23 % by [39] is higher than the value in this study and the obtained value in this study (54.81 %) is higher than 30.87 % reported by[30], 48.52 % by [36] for spent sorghum residues, 46.7 % by [38] for cassava peels, 51.77 % and 51.7 % reported by [31] for burukutu wastes and cassava peels respectively. This difference could be attributed to climatic and environmental conditions.

The Metabolizable Energy (ME) value (2435.65 kcal/kg) is less than 3271 kcal/kg by [28], 3670.70 kcal/kg by [29] and 3454 kcal/kg by [27] for maize and values of 3067.00 kcal/kg by [30], 3346.90 kcal/kg by [31], 2633.24 kcal/kg by [40] and 2832.42 kcal/kg by [37] but the reported value in this study is higher than 2259.70 kcal/kg by [39] for SDBG and comparable to 2551.69 Kcal/kg reported by [38] for dried cassava peels. This could be due to the varieties of cassava and sorghum used.

Therefore, the result of proximate composition of SSR-CP composite meal shows that it contains adequate amount of nutrients to replace maize in diets of farm animals.

3.2. Phytochemical Screening Of SSR-CP Composite Meal

The anti-nutrient result presented in Table 2 revealed the presence of alkaloids, tannins, flavonoids, saponins, tannins, oxalate and phytate in the sample analysed. Alkaloids exist in large proportions in the seeds and roots of plants and often in combination with organic acids. They have pharmacological applications as anesthetics and central nervous system stimulants [41,42]. Alkaloid content (10.00 mg/100 g) of SSR-CP is compared with 11.69 – 21.44 mg/100 g reported by [42] for cassava varieties but higher than 2.5 mg/100 g posited by [43] for dried plantain. This could be as a result of the varieties used. Flavonoids function to protect against allergies, inflammation, free radicals, platelet aggregation, microbes, ulcers, hepatotoxins, viruses, and tumors [44,42]. Flavonoid content value of 1.83 mg/100 g obtained is less than 96.91 – 1711.70 mg/100 g reported by [45] for white and purple skin sweet potato flesh and peel and 2.07 – 3.73 mg/100 g reported by [42]. The difference with different authors could be due climatic conditions.

Saponins are naturally occurring substances with various biological effects. In the presence of cholesterol, saponins exhibit strong hypocholesterolemic effect. They can also lead to hypoglycemia or impair the protein digestion, uptake of vitamins and minerals in the gut, as welllead to the development of a leaky gut [45,47,48,49]. Saponin content of 1.5 g/100 g is within 1.4 – 4.7 g/100 g reported by [50] for cassava leaf. This could be due to varieties, soil factors and processing methods.

Tannins exhibit anti-nutritional properties by impairing the digestion of various nutrients and preventing the body from absorbing beneficial bioavailable substances and are highly reactive and unstable compounds that can be physically, chemically and biologically degraded [51,52,53,49,54] and the most abundant of anti-nutritional factors in sorghum. The tannin content (16.00 g/100 g) of SSR-CP composite meal is though high compared to 8.19 g/100 g for yam, 8.51 g/100 g for maize and 9.20 g/100 g for bean reported by [55] but is less than 76.413 g/100 g reported by [54] for Sorghum Varieties. It has been reported that pigmented sorghum cultivars contains more tannins [56]. This could be attributed to the processing method. The phenol content 0.68 mg/100 g of SSR-CP composite meal is low compared to 2–120 mg/100 g posited by [50] and 9.86 – 133.92 mg/100 g by [45] for white and purple skin sweet potato flesh and peel. This could be attributed to quality difference.

High residual cyanide from poor processing and preparation is known to cause acute cyanide intoxication and goiters, and has been linked to ataxia (a neurological disorder affecting the ability to walk [57,42]. Hydro cyanide content in diet has been implicated for reduced growth rate (Iyayi and [58,59] as a result of interference with certain essential amino acids which could lead to decline in the utilization of associated nutrients [60,59].

Table 2: Phytochemical Screening of SSR-CP Composite Meal

Parameter	**Units**
Tannin	16.00g/100g
Saponin	1.50g/100g
Alkaloids	10.00mg/100g
Flavonoid	1.83mg/100g
Phenol	0.68mg/100g
Hydrocyanide	1.08mg/100g
Oxalate	213.7mg/100g
Phytate	92.80mg/100g

The hydro cyanide value (1.08 mg/100 g) is lower than the 2 – 200 mg/100 g reported by [50] and 5.16 mg/100 g for whole sorghum flour, 16.03 mg/100 g for malted sorghum flour and 7.23 mg/100 g for fermented sorghum flour reported by [61]. This could be attributed to the storage and processing methods used on the test diets.

Oxalic acid is toxic to the kidney and heart. Symptoms of mild oxalate poisoning include abdominal pains and gastroenteritis. In severe cases, it can cause diarrhea, vomiting, convulsions, non-coagulability of blood, coma and renal disease [62,42]. Oxalate content of SSR-CP (213.7 mg/100 g) in this study is higher than 0.61 – 1.54 mg/100 g reported by [63] on red type sorghum affected by soaking techniques, 0.4 – 23 mg/100 g observed in tubers reported by [49] but within 35 – 270 mg/100 g in grains reported by [49]. This could be due to climatic conditions.

Phytic acid is most concentrated in the bran of grains [64]. Their presence may affect bioavailability of minerals, solubility, functionality and digestibility of proteins and carbohydrates [65,49]. The phytate content of SSR-CP was found to be 92.8 mg/100 g, this is less than the range 170 – 380 mg/100g reported by [66], 270 mg/100 g and 230 mg/100 g for dark-colour seeds and light-colour seeds sorghum respectively reported by [67], 698 mg/100 g for fermented cassava peel and 1012 mg/100 g for unfermented cassava peels by [68]. This could be location of the test diets. These anti-nutrients present in the SSR-CP composite meal falls below and is within tolerable amounts that will have no detrimental effect or challenge the immune system of the rabbits and other farm animals.

3. Conclusion and Recommendation

4.1. Conclusion

Results obtained from this study on proximate composition of SSR-CP composite meal indicated that, SSR-CP composite meal shows that it contains adequate amount of nutrients and can be used successfully to replace maize, which is a conventional energy source.

These anti-nutrients present in SSR-CP composite meal falls within tolerable amounts that will have no detrimental effect or challenge the immune system of the rabbits and other farm animals.

4.2. Recommendation

The findings in this study will be beneficial to farmers as it will provide improved simple and cheap method of replacing maize with minimal cost so as tomaximise profit.To avoid high limitations, farmers (if possible) should know the variety, stage of maturity as well as proportions of sorghum, cassava peels and tuber.

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