EFFECTS OF SOAKING ON THE NUTRITIVE VALUE OF RAW FULL FAT RUBBER (*Hevea brasiliensis*) SEED

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ABSTRACT

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A study was conducted to investigate the effect of soaking Raw Full Fat Rubber Seed "RFFRS" in 2% wood ash solution on the proximate and anti-nutrient composition. RFFRS was obtained from Rubber Research Institute of Nigeria, Iyanomo. Benin City. The RFFRS was sun dried for five days and four samples were collected, dishelled and treated by soaking in 2% wood ash solution for 0, 24, 48 and 72 hours. The treated samples were analysed for proximate components and anti-nutritional factors. Soaking the RFFRS in 2% wood ash solution for 0, 24, 48 and 72 hours did not affect ($p>0.05$) crude protein, crude fibre and ether extract. The treatment however affected ($p<0.05$) ash, NFE and metabolizable energy. The crude protein numerically increased from 19.4% in RFFRS to 26.3% when soaked for 24hours. This later decreased numerically to 20.6% and 17.5% when soaked for 48 and 72 hours respectively. Soaking RFFRS in 2% wood ash solution indicated a significant ($p<0.05$) decrease in all the anti-nutrients measured. HCN decreased from 0.018mg/100g in RFFRS to between 0.009 and 0.006mg/100g when soaked for 24, 48 and 72 hours. Phytate levels declined from 0.7% in RFFRS to 0.4%, 0.5% and 0.3% when soaked in 2% wood ash solution for24, 48 and 72hours respectively. Tannin level decreased with increase in period of soaking while saponin, oxalate and anti-trypsin levels decreased at a similar level for all the soaking period. Treatment of RFFRS by soaking in 2% wood ash solution improved its nutrient content and also decreased its toxic level thus making it safer as feed ingredient for monogastric animal species.

INTRODUCTION

The Animal protein intake in the developing Countries has fallen short of requirement by the people. This has been attributed to the in-adequate feed ingredients that the animals require to give optimum performance (Rafiu *et al*., 2009). The in-adequacy of the conventional feed ingredients such as soya beans, groundnut cake, maize and millet among others is as a result of low supply and high competition between man and the livestock over this scarce commodity (Tuleun and Patrick, 2007). This situation has compelled the animal nutritionists in the developing countries such as Nigeria to focus on the alternative or non-conventional feed ingredients that can provide good quality nutrients with little or no adverse effects on the animals to ensure increased and sustainable animal products to its teaming population (Dafwang, 2006). The non –conventional feed ingredients have been evaluated in an attempt to reduce the cost of feed ingredients in livestock production. Some of such non-conventional feed ingredients include mucuna utilis (Tuleun and Patrick, 2007), lablab seed (Bawa *et al.,* 2003), mango seed kernel (Rafiu *et al.,* 2009), kolanut husk meal (Ojebiyi *et al.,* 2009) and baobab seed (Abdul *et al.,* 2009). Dafwang (2006) reported that despite the cheap nature of the non- conventional feed ingredients, they are found to have some limitations such as variations in quality, availability and presence of toxic substances .To overcome these limitations, there is need for the non- conventional feed ingredients to be processed so as to increase their nutritional qualities and reduce their toxic content to a safer level (Dafwang, 2006; Emeka and Olomu, 2007; Ogunka and Mepba, 2008).

Rubber seed is available in the southern part of Nigeria where it is mainly utilized as planting materials and in some cases Rubber seed oil production. Rubber seed oil has multiple industrial uses such as lubrication (Njoku and Ononogbu, 1995) printing ink and foaming agent in latex foam (Reethamma *et al.,* 2005), biodiesel (Remadhas *et al.,* 2005 and Ameena *et al. ,* 2012) paints and coating (Aigbodion *et al.,* 2003). A lot of findings on the nutritional assessment of rubber seed as a whole seed and as defatted have been reported for ruminant animals (Rajan *et al.,* 1990; Nguyen and Duong, 2003; Fuller, 2004 and Chanjula *et al.,* 2011) and monogastric animals (Nouke and Endeley.1990; Duong, 2003; Mmereole,2008).These findings reported full fat rubber seed as a good source of protein and energy especially for monogastric animals as it contains 11-35% crude protein (Oyewusi, 2007; Mmerele,2008 and Olomu, 2011) and 35-50% oil (Aigbodion *et al.,* 2003; Iyayi *et al.,* 2007 and Olomu, 2011).

Despite all these findings, rubber seed has not been adopted as livestock feed by livestock farmers in the rubber growing region due to the presence of toxic substances in it. It is glaring that rubber seed either full fat or defatted has a lot of potentials in reducing feed cost for livestock if properly harnessed. The presence of anti-nutritional factors in rubber seed has however restricted its utility as non- conventional feed ingredients in livestock diets. The anti-nutrients have been found to adversely affect protein and energy utilization by monogastric animals (Onu *et al.,* 2001). Processing rubber seed for livestock requires oil extraction in some cases. This is achieved by either solvent extraction or mechanical extraction which requires sophisticated equipments that are most often out of the reach of small scale poultry farmers. The small scale poultry farmers constitute a larger percentage of the total poultry farmers. The small scale poultry farmers in the rubber growing zone have access to rubber seeds around

them but cannot effectively use them to reduce the cost of poultry production. This therefore calls for a processing method that is simple that the small scale poultry farmers can take advantage of to increase their production and make available more poultry products for the teaming population. This paper is aimed at assessing the effect of soaking in wood ash solution as a processing method to improve the nutritional values of full fat rubber seed and to reduce the anti-nutrients to a very safe level that can help the poultry farmers maximize their profit.

MATERIALS AND METHODS

Source of rubber seed and processing

Rubber seeds were collected from the rubber plantation of Rubber Research Institute of Nigeria in Benin City, Edo State in the month of July /August. The rubber seeds were sundried for two weeks, bagged and stored for safety. Four samples of the seeds were collected and dishelled for treatment by soaking in a wood ash solution. The wood ash solution was prepared by dissolving 2 kg wood ash in 100 litres of water and allowed to stand for 24 hours as described by Abdu *et al.* (2009).The wood ash solution was then filtered and divided into three portions. Four samples of RFFRS (1.0 kg each) were separately soaked in the wood ash solution for 0, 24, 48 and 72hrs.The solution was stirred for 3-5 minutes at 12 hours interval. After each period of soaking, rubber seed was scooped out of the solution and sun dried for 5 days to a constant weight. Each Period of soaking served as a treatment. The dried samples were ground using a hand milling machine, stored in air tight bottles and taken for chemical analysis.

Proximate analysis

The dry matter, crude protein, ether extract, crude fibre, ash and Nitrogen free extract (NFE) were determined by the methods described in AOAC (1990). The total crude protein was determined by micro kjeldahl method. The nitrogen value was converted to protein by multiplying by a factor of 6.25.The crude fat content was determined by soxhlet extraction method using petroleum ether and Nitrogen Free Extract (NFE) was determined by subtraction difference method i.e. [100—(crude protein + crude fat + crude fibre + moisture + ash)].The ash content was determined as the residue remaining after incinerating the metabolizable energy of the sample at 600^0c for 3 hours in a muffle furnace. The metabolizable energy of the samples were estimated from the results of the proximate composition using the formula of Pauzenga (1985) (ME (kcal per kg) = 37 x % cp + 81 x %EE x 35.5% NFE).

Anti-nutritional factors

Hydrocyanic acid (HCN) and saponin contents were determined using the alkaline titration method of AOAC (1990) and method of AOAC (1995) respectively. Tannins were determined by method of Maga as described by Akinmutimi (2006), phytate was determined using the method of Davis and Reld as modified by Abulude (2004). Oxalate content was obtained by the method described by Munro and Bassil (1980). Trypsin inhibitor Activity (TIA) was determined using the procedure of Kaka as modified by Lin and Makaka (1989).

Data analysis

Data collected were analysed using one way analysis of variance (ANOVA) outlined in SPSS 15.0 version where the significant effects of the experimental diets were obtained and means were separated using Multiple Duncan Range Test.

RESULTS

The analysed proximate composition of the RFFRS and soaked full fat rubber seed ''SFFRS'' is presented in Table 1. The result revealed that Soaking RFFRS in a 2% wood ash solution was observed to have significant ($p<0.05$) effect on the dry matter, ash, nitrogen free extract and metabolizable energy. Soaking was however noticed to have no significant ($p>0.05$) effect on crude protein, crude fibre and ether extract. Soaking RFFRS for 24 hours numerically increased the crude protein level from 19.4% to 26.3%. This later decreased to 20.6% and 18.1% when soaked for 48 and 72hours respectively. Metabolizable energy was observed to significantly ($p<0.05$) increased when RFFRS was soaked in wood ash solution for 48 hours. The result for anti- nutrients content of the RFFRS and SFFRS is presented in Table 2. Soaking in 2% wood ash solution was observed to have a significant ($p<0.05$) effect on all the anti-nutrients content of RFFRS. Soaking RFFRS in 2% wood ash solution was observed to significantly decrease the content of HCN, phytates, tannin, saponins, oxalate and trypsin inhibitors. Trypsin inhibitors decreased from 128.7 Tui per mg in RFFRS to 38.3, 27.3 and 21.1 Tui per mg when soaked for 24, 48 and 72 hours respectively. The decrease in trypsin inhibitors when soaked for 24, 48, and 72 hours was observed to be at a significantly similar level. Phytates, saponins and trypsin inhibitors were decreased from 0.7, 2.1 and 128.7 respectively in RFFRS to ranges of 0.3 to 0.5 mg per 100g, 0.0 to 0.1mg per 100g and 21.2 to 38.2Tui per mg respectively when soaked for between 24 to 72 hours.

Table 1: Proximate composition of RFFRS and SFFRS

Parameters	0Hours RFFRS	24Hours SFFRS	48Hours SFFRS	72Hours SFFRS	SEM
Dry Matter (%)	97.2c	98.7a	98.2b	97.1c	0.207*
Crude protein (%)	19.4	26.2	20.6	18.1	1.792ns
Crude fibre (%)	4.5	3.7	3.7	3.6	0.306ns
Ether extract (%)	45.5	50.5	52.0	52.0	2.262ns
Ash (%)	5.9b	6.3ab	6.8ab	7.2a	0.206*
NFE (%)	25.9a	11.3b	24.1a	20.5ab	2.289*
ME (kcal per kg)	5321.7b	5462.7b	5828.3a	5609.5b	78.345*

Means on the same row with different superscripts are significantly different ($p< 0.05$); ns = non-significant ($p> 0.05$), SEM = Standard error of mean; RFFRS = raw full fat rubber seed; SFFRS =soaked full fat rubber seed; NFE =Nitrogen free extract; ME = Metabolisable energy, ME (kcal per kg) = 37 x %CP + 81 x %EE +35.5 X %NFE (Pauzenga, 1985)

Table 2: Anti-nutrients content of raw and SFFRS

Anti-nutrients	Treatments				
	1 Raw	2 24 hours	3 48 hours	4 72 hours	SEM
HCN(mg per 100g)	0.018a	0.009b	0.006b	0.006b	0.0016*
Phytate (%)	0.74a	0.42b	0.46ab	0.26b	0.064*
Tannin (mg per 100g)	1.02a	0.34b	0.24bc	0.12c	0.107*
Saponins (mg per 100g)	2.06a	0.00b	0.00b	0.06b	0.272*
Oxalate (mg per100g)	0.24a	0.012b	0.021b	0.010b	0.0034*
Trypsin Inhibitors(Tui per mg)	128.76a	38.26b	27.29b	21.16b	13.395*

Means on the same row with different superscripts are significantly different ($p<0.05$).
HCN = Hydrocyanic acid; SEM = Standard error of mean; SFFRS = Soaked full fat rubber seed

DISCUSSION

Soaking RFFRS in 2% wood ash solution for 24 hours gave the highest numerical level of Crude Protein (26.3%) as against 20.6% and 17.5% when soaked for 48 hours and 72 hours respectively. The 26.3% Crude Protein compared favorably with 28.6% CP for rubber seed meal (RSM) reported by Ijaiya *et al.* (2011), lower than 34.1% CP for defatted RSM (Mmereole, 2008), 30% CP for defatted RSM (Iyayi *et al.*,2008), higher than 21.9% and 17.4% CP for defatted and un-defatted rubber seed (Oyewusi *et al.*, 2007 and Eka *et al.*, 2010) respectively. The crude protein for RFFRS soaked for 24, and 48 hours fall within the range regarded as protein source for monogastric animals (Olomu, 2011). Crude protein was observed to increase from 19.4% in RFFRS while soaking for 24 and 48 hours increased crude protein from 19.4% in RFFRS to 26.3% (24 hours) and 20.6% (48 hours) and decreased from 26.3% (24 hours) to 20.6% (48 hours) and 17.4% (72 hours). The lower crude protein values observed when RFFRS was soaked for 48 and 72 hours is an indication of solubilization and loss of their nitrogenous compounds as reported by Abdu *et al.* (2009).

The ether extract values for RFFRS and SFFRS (36.2 - 52.0%) fall within the values of 37.5-68.5% for undefatted rubber seed reported by Ukpebor *et al.* (2007), Oyekunle and Omode (2008); Eka *et al.* (2010), Olomu (2011). The ether extract values for SFFRS (50.5-52.0%) are higher than values for groundnut (46.5%), Sesame (49.9%) and Canola seeds (39.2%) as reported by Olomu (2011) and Aduku (1993). Ether extract (crude fat) has been reported to be the course of fat in feeds which influences and improves feed digestibility in farm animals (Bun *et al.,* 2002; Nguyen and Ly, 2002). It has been reported that the presence of high level of ether extract in full fat rubber seed could make it a potential replacement or partial substitute for maize in the diets of farm animals (Oyewusi *et al.,* 2007).The ash content of 2.8 - 5.1% observed for RFFRS and SFFRS is similar with the values of 3.1% reported for undefatted rubber seed (Eka *et al.,* 2010) and 4.6%, 6.5% and 6.4% reported for defatted rubber seed by Ijaiya *et al.* (2011) and Madubuike *et al.* (2006) respectively.

The NFE values observed for the RFFRS and SFFRS (16.3-25.9%) were similar to the values of 18.2% (Ravindran and Ravindran,1988), 20.4% (Olomu,2011) and 14.6% (Ijaiya *et al.,* 2011) reported for rubber seed .The NFE values for both the RFFRS (25.9%) and SFFRS (11.3-24.1%) also compared favourably with conventional feed protein sources such as groundnut cake (22.7%) and full fat Soya bean meal (21.6%) as reported by Olomu (2011).This implies that FFRS has a reasonable amount of total digestible carbohydrates..

The estimated ME values of 5,851.42 to 6,349.90 Kcal/kg observed for RFFRS and SFFRS was far higher than the values of 2750, 2460 and 2069 ME(Kcal per kg) reported respectively for groundnut cake, soyabean cake and cotton seed cake (Olomu,2011). The high metabolizable energy values for the RFFRS and SFFRS is an indication that rubber seed could be a good energy sources in monogastric diets.

The result for the anti-nutrient content of RFFRS and SFFRS is shown in Table 2. All the anti-nutrients in the RFFRS were significantly decreased ($p<0.05$) when soaked in wood ash solution for periods of 24, 48 and 72 hours. The values of 0.006 to 0.009 mg per 100g observed for HCN fall below the tolerant levels of 100ppm

(Ahluwalia and Delege, 1983) and 3 mg per kg (Leuschuer *and* Leuschuer, 1995) reported to be safe for monogastric animals .The decrease in phytate level to between 0.3 and 0.4% was observed to be lower when compared to the phytate level of maize (146 to 353 mg per kg) and sorghum (206 to 280 mg per kg) (Concon, 1988). The 0.12 to 0.34 mg per 100g tannins available in the processed rubber seed was lower than 0.4 to 0.5% reported to be safe for monogastric animals (Ukpebor *et al.,* 2007). Saponin was decreased to between 0.00 and 0.06 mg per 100g. Although some saponins have been revealed to be highly toxic under experimental conditions, acute saponin poisoning in both animals and humans is relatively rare (Osagie, 1989). A reduction in oxalate to between 0.001 and 0.021 mg per 100g were observed. These levels were far below the toxic level of 2 to 5 mg per 100g reported by Munro and Bashir (1980).

CONCLUSION AND RECOMMENDATION

From the results of these findings, it was observed that soaking RFFRS in 2% wood ash solution improved the proximate component especially Crude protein, ether extract and metabolisable energy. Soaking RFFRS in 2% wood ash solution for 24 hours also reduced the anti-nutrients content of RFFRS to safe levels.

It is therefore recommended that RFFRS be soaked in 2% wood ash solution for 24hrs to improve its nutritive value especially for monogastric animals.

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