Evaluation of Proximate and Phytochemical Compositions of Fermented Raw and Fermented *Napoleona Imperialis* Seed and Their Feeding Values on Finisher Broilers

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Abstract: The high cost of feed in poultry enterprise is well established. This is blamed on limited availability of conventional feedstuff which is also in competition with man's dietary needs. This has necessitated the search for alternative protein sources such as *Napoleona imperialis* seed. Ripe *N. imperialis* seeds (NISs) were harvested in and around the Federal University of Technology, Owerri with the pods opened, the seeds extracted, and sun dried for 7 days. A portion of the sundried NIS was milled using hammer mill to produce the raw *N. imperialis* seed meal (NISM) while, the remaining portion was soaked in water for 4 days and sundried before milling to produce soaked NISM. Samples of raw and soaked NISMs were taken to the laboratory to determine its proximate and phytochemical compositions. Phytate, tannins, HCN, alkaloids, saponins and metabolisable energy value of the raw NISs were significantly ($p<0.05$) affected by the treatment. Birds on control diet performed significantly ($p<0.05$) better than those on 10% soaked NISM diet in terms of average daily feed intake and feed conversion ratio but similar ($p>0.05$) to those on 5% raw and 5% soaked NISMs. The average daily weight gain of birds on 5% raw and 10% soaked NISMs was significantly ($p<0.05$) lower than the control group. It is concluded that soaking for 4 days in water do not reduce the anti-nutritional content of *N. imperialis* seeds to a tolerable level for broilers. [Nature and Science 2010;8(4):83-88]. (ISSN: 1545-0740).

Keywords: novel seeds, proximate composition, phytochemistry, performance, broilers.

1. Introduction

The high cost of feed components as a variable in poultry enterprise is well established (Igboeli, 2000; Esonu, 2006). The high cost is blamed on limited availability of conventional feedstuff which are also competed for by man. This has necessitated the search for alternative feed ingredients. One of such alternative feed ingredient is *Napoleona imperialis* seed.

Napoleona imperialis (P. Beavr) belongs to the family *lecythidaceae* which is an evergreen non-timer plant that grows abundantly in bush fallows, secondary bushes and marginal lands in most of the tropical humid zone of West Africa (Koppel, 1990). People consume the juice from the pods and discard the seeds. The seeds appeared to have very low human food preference, little or no industrial use as at now.

Uchegbu *et al.* (2004) reported that raw *Napoleona imperialis* seed meal had 4.8% moisture, 11.7% crude protein, 4.9% ether extract, 3.6% crude fibre and 3.52% ash. The mineral content of *Napoleona imperialis* seed meal included 5.01g/kg calcium, 17.5g/kg potassium and 16.1 g/kg sodium (Ukpabi and Ukpabi, 2003). Iheukwumere and Okoli (2002) and Iheukwumere *et al.* (2002) fed the raw dried seeds to weaner rabbits and observed that at 15% inclusion, the seeds had no visible deleterious effects on growth rate, haematology and serum biochemical values. Uchegbu *et al.* (2004) recorded a good performance on finisher broilers fed 5% inclusion level of raw *Napoleona imperialis* seed meal, noting that beyond 5% level the performance was poor.

Napoleona imperialis seeds were reported by Uchegbu *et al.* (2004) to contain anti-nutritional factors and toxic elements such as saponin, tannin, flavonoid, phytate, alkaloid, cyanogenic glucosides and cardiac glucosides. In plants, saponin serves as anti-feedants and protects the plant against microbes and fungi attack. Saponins are often bitter to taste and so can reduce plant palatability. Radostits *et al.* (1997) reported that saponins could cause gastroenteritis, manifested by diarrhoea and dysentery. Westendarp (2005) reported negative effects of saponins on performance of farm animals. Oxalate decreases the availability of dietary essential minerals (calcium) at high concentration and causes death in animals due to its corrosive effects (Kumar and D'mello, 1991). Cyanogenic glucosides inhibit the energy giving oxygen linked respiratory activities in the cellular mitochondria (Lehnimger, 1975).

Numerous studies (Uchegbu *et al*., 2004; Ofoegbu, 2008; Osuagwu, 2008) have confirmed the presence of anti-nutritional factors in raw *Napoleona imperialis* seeds and the resulting negative performance of animals fed these seeds.

There is need to access the extent to which processing (soaking in water) will enhance the utilization of *Napoleona imperialis* seeds for monogastric animals, especially broilers. Therefore, the objective of the study was to evaluate the effect of four days fermentation on proximate and phytochemical compositions of raw *Napoleona imperialis* seed and as well as its feeding values in finisher broilers diets.

2. Materials and Methods

2.1 Experimental Site

This research was carried out in the Poultry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo state. It is situated in southeastern agro-ecological zone of Nigeria. The vegetation is typically rainforest with two seasons, the rainy and dry seasons. The period of rainy season is from the month of April to October, while the dry season runs through November to March. Imo state lies between latitude 4^{o} 4' and 6^{o}3' N and longitude 6^{o}15' and 8^{o}15' E.

2.2 Plant collection and authentication

The riped *Napoleona imperialis* seeds were harvested in and around the Federal University of Technology, Owerri. The scientific name was authenticated in the Department of Crop Science and Technology, Federal University of Technology, Owerri by Dr. I.I. Ibeawuchi.

2.3 Processing *Napoleona imperialis* seed into meal

Fresh matured *N. imperialis* pods opened, seeds removed (Plate 1) and sun dried for about 9 hours every day for 7 days. A portion of the sun dried *N. imperialis* seeds was milled using hammer mill to produce the raw *Napoleona imperialis* seed meal while, the remaining portion was soaked in water for four (4) days, sun dried and milled to produce soaked *N. imperialis* seed meal. Samples of raw and soaked *Napoleon imperialis* seed meals were taken to the laboratory for proximate and phytochemical analyses.

Plate 1. *Napoleona imperialis* seeds

2.4 Phytochemical and proximate analysis

Determination of tannin content of *Napoleon imperialis* seeds was done by the ferric chloride test as described by Harborne (1973). The presence of flavonoids in the test was determined by the acid alkaline test (Harborne, 1973). Saponin was gotten from emulsion test with aqueous extracts. Alkaloid was obtained by dispensing samples in Ethanol and Mayer's reagent. Phenol was determined according to the folic ciocciteon calorimetric method (A.O.A.C, 1990). HCN was gotten by the alkaline picrate colorimetric method. Phytate was determined by the spectrophotometer method of Oberlease (2003). The proximate composition of raw and soaked *Napoleon imperialis* seed meal was determined using the standard procedures of A.O.A.C. (1990).

2.5 Experimental design

Two hundred Anak finisher broilers were divided into four treatment groups of fifty birds each. Each treatment group was subdivided into five replicates of ten birds each. Four treatment diets 0% (control), 5% raw

($T_{5\%R}$), 5% soaked ($T_{5\%S}$) and 10% soaked ($T_{10\%S}$) NISMs were formulated (Table 1) and fed to finisher broilers in completely randomized design experiment for 35 days.

Table 1: The ingredient compositions of experimental diets fed to finisher broilers

Ingredient	% Diets (Napoleona imperialis seed meal)			
	$T_{0\%}$	$T_{5\%R}$	$T_{5\%S}$	$T_{10\%S}$
Maize	60	55	55	50
Napoleona imperialis seed meal	0	5.0	5.0	10.0
Calculated nutrient analysis				
Crude protein	20.4	20.7	20.7	20.8
Crude fibre	4.11	4.16	4.16	4.18
Ether extract	4.28	4.31	4.37	4.40
ME (Kcal/kg)	2950.99	2948.92	2947.83	2942.14

Each diet contained 20% soybean meal, 6% wheat offal, 3% palm kernel cake, 4% fishmeal, 3% blood meal, 2% bone meal, 1% oyster shell, 0.25% methionine, 0.25% lysine, 0.25% vitamin / mineral premix, 0.25% common salt. Vitamin/ premix provides the following per kg of feed: vitamin A, 10,000iu; vitamin D_3, 2000iu; vitamin E, 5iu; vitamin K, 2mg; riboflavin, 4.2mg; vitamin B_{12}, 0.01mg; panthothenic acid, 5mg; nicotinic acid, 20mg; folic acid, 0.5mg; Choline, 3mg; magnesium, 56mg; iron, 20mg; copper, 1.0mg; zinc, 5.0mg; cobalt, 1.25mg; iodine, 0.8mg; R - raw; S - soaked.

2.6 Data analysis

Statistical differences between treatment means were determined with the one way analysis of variance for completely randomized design (Steel and Torrie, 1980). Data on proximate composition and phytochemical composition were statistically analyzed using the t - test procedure of Snedecor and Cochran (1978). Where significant differences were detected between treatment means, mean separation was done using Duncan's New Multiple Range Test as outlined by Obi (1990).

3. Results

3.1 Phytochemical compositions: The phytochemicals compositions of raw and soaked *Napoleona imperialis* seeds are shown in table 2. The tannins, phytate, HCN, alkaloids and saponin values were significantly ($p<0.05$) reduced by soaking in water for 4 days. All other parameters measured including oxalate and autocyanin were similar ($p>0.05$) between the two treatments.

Table 2: The quantitative phytochemical composition of raw and soaked *Napoleona imperialis* seed

Parameters	Raw NIS	Soaked NIS
Oxalate	0.85	0.73
Tannins	1.35^a	0.84^b
Phytate	1.56^b	0.96^a
HCN (mg/kg)	18.74^a	9.52^b
Autocyanin	0.43	0.41
Alkaloid	0.56^b	0.38^a
Saponin	0.68^b	0.48^a

^{ab}Means within row with different superscripts are significantly ($p<0.05$) different. NIS - *Napoleona imperialis* seed.

3.2 Proximate compositions: The proximate compositions of raw and soaked *Napoleona imperialis* seeds are presented in table 3. The results showed that soaking *Napoleona imperialis* seeds in water for 4 days had no significant effect ($p>0.05$) on the crude protein, crude fibre, ether extract, ash, nitrogen free extract, moisture and dry matter. Soaking *Napoleona imperialis* seeds in water for four days significantly ($p<0.05$) lowered the metabolisable energy value.

Table 3: The proximate compositions of raw and soaked *Napoleona imperialis* seed

Parameters	Raw NISM	Soaked NISM
Moisture	11.26	12.81
Dry matter	88.74	87.19
Ash	3.82	3.31
Crude fibre	4.11	3.71
Ether extract	4.93	3.62

Crude protein	14.84	15.35
Nitrogen free extracts	61.04	61.2
ME (Kcal/kg)	2618.98[a]	2494.00[b]

[ab]Means within row with different superscripts are significantly ($p<0.05$) different; NISM - *Napoleona imperialis* seed meal.

3.3 Growth performance: The effects of raw and soaked *Napoleona imperialis* seed meals on performance of finisher broilers are shown in table 4. The average final body weights of the control birds were significantly ($p<0.05$) higher than the group fed 10% soaked *N. imperialis* seed meal diet. The average daily feed intakes of birds on control diet were not significantly ($p>0.05$) different from birds fed 5% raw and soaked NISM, but significantly ($p<0.05$) higher than those fed 10% soaked NISM diet. There was significant difference ($p<0.05$) in average daily weight gain of birds fed control diet relative to those on 10% soaked NISM diet. The mortality recorded in the study was numerically ($p>0.05$) higher and could be attributed to the *Napoleona imperialis* seed meal diet.

Table 4: The performance characteristics of finisher broilers fed raw and soaked *Napoleona imperialis* seed meal based diets

Parameter	***Napoleona imperialis* seed meal diets (%)**				**SEM**
	$T_{0\%}$	**$T_{5\%R}$**	**$T_{5\%S}$**	**$T_{10\%S}$**	
Avg. initial body weight (kg)	0.84	0.82	0.90	0.87	0.05
Avg. final body weight (kg)	1.24[a]	1.03[a]	1.19[a]	0.98[b]	0.07
Avg. daily weight gain (kg)	0.40[a]	0.21[ab]	0.29[ab]	0.11[b]	0.05
Avg. daily feed intake (g)	110.0[a]	100.0[a]	103.3a	70.0[b]	10.24
Feed conversion ratio (g feed / g gain)	4.94[b]	7.50[b]	8.50[b]	17.81[a]	2.25
Mortality (%)	3.30	4.80	10.60	14.30	

[a,b]Means within row with different superscripts are significantly ($p<0.05$) different. R - Raw, S - Soaked, SEM – Standard error mean.

4. Discussion

The reduction in phytate level of soaked *N. imperialis* seeds in the present study is in agreement with the earlier findings of Alonos *et al*. (1998) in *Faba* bean seeds soaked in water. The reduction in phytate content of raw *Napoleona imperialis* seeds during soaking could be attributed to leaching out along the concentration gradients (Kataria *et al*., 1989). The phytates (a poly phosphoric ester of inositol) are known to increase the requirement for minerals, especially phosphorus, which form insoluble complexes with phytic acid. The reduction in saponin content was in line with similar losses of saponin in fermented Baobab seeds (Umaru *et al.*, 2006). The 18.74 mg/kg HCN values found in raw *Napoleona imperialis* seed was much lower than those found in cowpea seeds (40 mg/kg), and was beyond the upper limit of 10 mg/kg HCN reported to be safe for human consumption (Oke *et al*., 1996; Makkar and Becker, 1997).

The crude protein content of the soaked *Napoleona imperialis* seeds was relatively higher when compared with the raw seeds. This agrees with the results of Yashim *et al.* (2009) that soaking improves the protein content of raw seeds. The reduction in ether extracts of *Napoleona imperialis* seeds soaked in water relative to raw *Napoleona imperialis* seeds was in contrast with the reports of Omafuvbe *et al*. (2004) on African locust bean seeds. The decrease in ash content of soaked *Napoleona imperialis* seeds was in agreement with the findings that ash decreased with soaking as reported on Delichous lablab beans by Osman (2007).

The decreases in final body weight of the birds fed 5% raw and 10% soaked NISMs could be attributed to the presence of anti-nutritional factors contained in raw *N. imperialis* seeds which prevent optimal utilization of nutrients in *N. imperialis* seed meal. The comparable result in final body weight of broilers fed control and 5% soaked NISM diets was an indication that soaking in water for 4 days might have reduced the anti-nutritional contents to a tolerable level. Higher level of anti-nutritional factors has been implicated in lowering nutrient availability and absorption in animals (Kumar and D'mello, 1991).

The significant difference in average daily weight gain of birds fed control diet relative to those on 10% soaked NISM diet. This reflects the inability of these birds to adequately handle and tolerate the anti-nutritional factors at this level of inclusion of soaked NISM. The results of the average daily weight gain of the birds on control diet were in agreement with the findings of Uchegbu *et al*. (2009) that birds fed control diet performed significantly better than those fed raw and soaked NISM diets. The reasons for the depressed performance in these birds could be associated with the anti-nutritional factors contained

in *Napoleona imperialis* seed meal (Uchegbu *et al*., 2009).

Feed conversion ratio (FCR) of the birds fed 10% soaked NISM was significantly ($p<0.05$) higher than the other three groups. The numerically lower FCR value recorded in control birds relative to those on the other 3 treatment groups was an indication that control diet was better utilized by these birds. The poorest result in FCR of birds on 10% soaked NISM diet was in support with the findings of Uchegbu *et al.* (2009) who reported the same result in finisher broilers fed 10% cooked NISM diet. The implication was that soaking in water for 4 days did not achieve a significant improvement in the reduction of the anti-nutritional content of *N. imperialis* seeds, and thus did not improve the utilization of *Napoloena imperialis* seed meal diets.

The negative effects of *N. imperialis* seed on feed intake have been reported by numerous researchers (Uchegbu *et al*., 2004; Westendarp, 2005; Radostits *et al*., 1997). It appeared that anti-nutritional factors (e.g. saponins) created a palatability problem (Ogbonna, 1983) which suppressed the intake of diet with 10% soaked *Napoleona imperialis* seed meal. The implication is that soaking slightly improved the utilization of NISM diet at 5% soaked relative when compared to those fed 5% raw NISM. In view of the fact that all the diets met the nutrient requirement for finisher broilers (Esonu, 2006) yet the birds assigned to these diets performed poorly support the report of Iyayi (2004) that a feed may contain adequate amount of nutrients in balanced proportions, yet these nutrients may not be available to the animals.

4. Conclusion

From the results obtained it can be concluded that inclusion of raw and soaked *Napoleona imperialis* seed meal in the diet of finisher broilers resulted to visible deleterious effect on performance. Although soaking *Napoleona imperialis* seeds in water for four days improved its utilization by broilers, but not to the extent of incorporating it up to 10%. Therefore more detail research is required to determine the appropriate methods of processing raw *Napoleona imperialis* seeds.

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