ANTI-NUTRITIONAL FACTORS OF TWO COWPEA VARIETIES AS INFLUENCED BY IRRIGATION INTERVAL AND PHOSPHORUS APPLICATION RATES IN ZARIA, NIGERIA

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ABSTRACT
A field experiment was conducted to evaluate the effects of irrigation intervals and phosphorus application rates on anti-nutritional factors of two cowpea varieties during 2018 and 2019 dry season. The experiment was laid out in a 2×3×3 factorial arrangement in a split plot design with three replications. Treatments consisted of 2 cowpea varieties (SAMPEA 14 and 15), 3 flood irrigation intervals (5, 10 and 15-days) and 3 phosphorus (P) rates (0, 20 and 40kg/ha), respectively. Results indicated that higher ($P<0.05$) saponin and phenol contents were recorded with respect to Sampea 15 haulm variety compared to Sampea 14 variety of cowpea haulm. Irrigation interval of 15 days led to higher phenol and oxalate concentration compared to frequent irrigation intervals (5 days). The phenol and oxalate concentrations increased by 18.0% and 23.7%, respectively in the longest irrigation interval as compared to the shortest irrigation interval. It was therefore, concluded that farmers should irrigate SAMPEA 14 using the 5 day irrigation interval in combination with 20 kgP/ha of phosphorus application rate for optimum cowpea haulm quality.
Key words: Anti- nutritional, phosphorus rates, irrigation, cowpea, varieties

INTRODUCTION
The presence of anti- nutritional substances in any of the edible legumes is of major concern. The toxicity due to the consumption of various forages is very common among the farm animals. Cowpea (*Vigna unguiculata* L.Walp) has been utilized as a supplement feed to enhance feed intake and improve productivity in ruminants fed low-quality roughage diets (Etana *et al*., 2013). Cowpea forage contain anti-nutritive factors which includes, but not limited to; tannins, oxalate, saponins, phytate and phenol (Cai *et al*., 2003). These anti-nutritional factors are chemical compounds present in the diet which by themselves or their metabolic products arising in the system interfere with the feed utilization (Aganga, 2003), reduce production or affects the health of the animal. The anti-nutritive substances are often referred to as toxic factors because of deleterious effects they produce when eaten by animals (Reddy, 2007). Therefore, this study was conducted to evaluate the anti-nutritional factors of two cowpea varieties as influenced by irrigation interval and phosphorus application rates in Zaria, Nigeria due to their major concern.

MATERIALS AND METHODS
A field experiment was conducted at the irrigation site of the Institute for Agricultural Research (IAR) Samaru, Zaria. The experiments were laid out in a 2×3×3 factorial arrangement in a split plot design with three replications. The treatments consisted of combinations two cowpea varieties (SAMPEA 14 and 15), three irrigation intervals (5, 10 and 15 days) and three phosphorus application rates (0, 20 and 40 kgP/ha), respectively. Cowpea varieties and irrigation interval were assigned as the main plots, while the phosphorus application rates were placed in the sub-plots by incorporated into the soil before sowing. Irrigation was carried out at 3 day intervals by the use of surface flooding before the actual irrigation treatment commenced at 3 weeks after sowing (WAS). The haulms from the cowpea varieties were sun-dried, chopped and subsamples were milled with a hammer mill fitted with a 3 mm sieve for analyses of anti-nutritional factors using the method described by AOAC (2005). Data collected were subjected to analysis of variance (ANOVA) using Anova by General Linear Model (GLM), Procedures of Statistical Analysis System (SAS) version 9 (SAS, 2003). Treatment means were separated using Dunnetts test.

RESULTS AND DISCUSSION

The effect of irrigation interval and phosphorus (P) application rates on anti-nutritional factors of two varieties of cowpea haulm during 2018 and 2019 dry seasons is presented on table 1. There was no significant difference (P>0.05) in all the anti-nutritional factors determined between the two varieties of cowpea haulm except for saponin and phenol during the 2019 trial period. Higher (P<0.05) saponin and phenol contents were recorded with respect to Sampea 15 haulm variety compared to Sampea 14 variety of cowpea haulm. The variations in saponin and phenol concentrations between the two varieties of cowpea haulm during the 2019 trial period might be due to the year of establishment, plant varieties and level of maturity at harvest. Feedstuffs containing saponin have been found to inhibit microbial fermentation (Habtamu and Negussie, 2014). In this study the concentration is very low and safe for ruminants as the tolerable level of saponin in goat is 1.5 – 2% (Onwuka, 1983). All the anti-nutritional factors determined were similar (P>0.05) across the irrigation intervals except for phenol and oxalate during the 2018 trial period. Irrigation interval of 15 days led to higher phenol and oxalate concentration compared to frequent irrigation intervals (5 days), although irrigation interval of 5 and 10 days were observed to be similar. The phenol and oxalate concentrations increased by 18.0% and 23.7%, respectively in the longest irrigation interval as compared to the shortest irrigation interval. It is observed that frequent moisture supply leads to lower phenol and oxalate concentration than longer irrigation interval. It may therefore seem reasonable to suggest irrigation interval of 5 days influenced lower concentration of phenol and oxalate. Phenols have an antioxidant activity function to protect cells from oxidative stress which has been implicated in the cowpea leaves (Chikwendu *et al*. 2014; Adjei-Fremah, 2015). The total phenol concentration from the study were low, which suggest no or minimal detrimental effects on protein levels adequate to promote fibre digestion in the rumen. This phenomenom could reduce live weight losses in ruminants in rural areas, most especially during the dry season where crop residues are the main feed resource.

Similarly, oxalate contents were lower than the 10% oxalate concentration on dry weight bases known to cause toxicity (Makkar, 1991). In ruminants oxalate is of only minor significance as an anti-nutritive factor since ruminants can consume considerable amounts of high oxalate plants without adverse effects, principally due to microbial degradation in the rumen (Reddy, 2007; Habtamu and Negussie, 2014). The non similarity in all the remaining anti-nutritional factors determined during the two years trial and the mean across the treatments could possibly be that; variety, irrigation intervals and phosphorus application rates are not major factors affecting the anti-nutrients of cowpea. The concentrations range levels of tannins which in pasture legumes decrease palatability and protein digestibility (Makkar, 1991; Akande *et al*., 2010; Smitha *et al*., 2013). In this study, tannin concentration is very low and safe for ruminants as tannin concentration of 4% DM (40 - 100g/kg DM) in pasture legumes was reported to be toxic (resistant to microbial attack) for ruminants (Habtamu and Negussie, 2014) and interfere with intake, digestion and utilization of forages at a critical value above 5% DM (Mokoboki *et al*. 2000; Adjei-Fremah *et al*. 2015). Ravhuhali *et al.* (2011) reported that some cowpea forage cultivars had high amounts of condensed tannins (0.11% DM basis), but this did not exert negative effects on intake and digestibility. Goats are known to have a threshold capacity of 9% DM (90 g/kg DM) dietary tannin (Nastis and Malachek, 1981). However, the cowpea haulms from the two varieties contain low tannin, saponin, phenol and oxalate which can be tolerated by ruminants.

Table 1: Anti-nutritional factors (mg/100kg DM) of two varieties of cowpea haulm as influenced by irrigation interval and phosphorus application rates during 2018 and 2019 dry seasons.

Treatments	Tannin			Saponin			Phenol			Oxalate		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Variety (V)												
SAMPEA 14	5.32	5.96	5.64	1.70	1.62[b]	1.66	325.54	295.19[b]	319.36	0.68	0.49	0.58
SAMPEA 15	5.47	5.74	5.60	1.69	1.74[a]	1.71	298.24	339.31[a]	318.77	0.72	0.39	0.55
SEM	0.50	0.30	0.40	0.23	0.24	0.23	5.48	5.31	5.39	0.21	0.37	0.29
Irrigation interval, days (I)												
5	5.21	5.77	5.49	1.68	1.67	1.67	283.22[b]	339.54	311.30	0.43[b]	0.71	0.57
10	5.59	6.07	5.83	1.69	1.69	1.69	308.32[b]	321.00	314.66	0.29[b]	0.73	0.51
15	5.39	5.71	5.55	1.71	1.68	1.69	319.13[a]	329.21	324.17	0.59[a]	0.67	0.63
SEM	0.50	0.30	0.40	0.23	0.24	0.23	5.48	5.31	5.39	0.21	0.37	0.29
Phosphorus rates, kgP/ha (P)												
0	5.35	5.52	5.43	1.72	1.69	1.70	308.04	310.24	309.14	0.69	0.45	0.57
20	5.59	6.12	5.85	1.69	1.68	1.68	310.06	311.33	310.69	0.70	0.39	0.54
40	5.24	5.91	5.57	1.66	1.66	1.66	317.57	330.19	317.57	0.70	0.47	0.58
SEM	0.50	0.30	0.40	0.23	0.24	0.23	5.48	5.31	5.39	0.21	0.37	0.29
Interaction												
V × I	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V × P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I × P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V ×I × P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[abc] Means with different superscripts along the column differed significantly (P<0.05) SEM = Standard error of means

CONCLUSION

From this study, it can be concluded that farmers should irrigate SAMPEA 14 using the 5 day irrigation interval in combination with 20 kgP/ha of phosphorus application rate for optimum cowpea haulm quality.

REFERENCES

Adjei-Fremah, S., Louis, E. N. J and Mulumebet, W. (2015). Analysis of phenolic content and antioxidant properties of selected cowpea varieties tested in bovine peripheral blood. *American journal of animal and veterinary sciences.*10 (4): 235-245.

Aganga, A. A. and Tshwenyane, S. O. (2003). Feeding values and Anti –Nutritive factors of forage tree legumes. *Pakistan Journal of Nutrition. 2(3):170-177.*

Akande, K. E., Doma, U. D., Agu, H. O and Adamu, H. M. (2010). Major Antinutrients Found in Plant Protein Sources: Their Effect on Nutrition. *Pakistan Journal of Nutrition*. 9 (8): 827-832.

AOAC. (2005). Official Methods of Analysis of Association of Official Analytical Chemist, 17th Edition, Washington D. C., U. S. A.

Cai, R., Hettiarachchy, N. S. and Jalaluddin, M. (2003). High-performance liquid chromatography determination of phenolic constituents in 17 varieties of cowpeas. *Journal of Agriculture and Food Chemistry*. 51: 1623-1627.

Chikwendu, J. N., Igbatim, A. C and Obizoba, I. C. (2014). Chemical composition of processed cowpea tender leaves and husks. *International Journal of Scientific Research*. Publication 4: pp 1-5.

Etana, A., Tadesse, E., Mengistu, A. and Hassen, A. (2013). Advanced evaluation of cowpea (*Vigna unguiculata)* accessions for fodder production in the central rift valley of Ethiopia. *Journal of Agricultural Extension and Rural Development*. 5(3): Pp 55-61

Habtamu, F. and Negussie, R. (2014). Antinutritional factors in plant foods: Potential health benefits and adverse effects. *International Journal of Nutrition and Food Sciences*, 3(4): 284-289.

Makkar, H. P. S. (1991). Antinutritional factors in animal feedstuffs-mode of action. *International Journal of Animal Science*., 6: 88-94.

Mokoboki, H. K., Ayisi, K. K and Ndlovu, L. R. (2000). Chemical composition and physical characteristics of cowpea haulms as forage for ruminants. *South African Journal of Animal Science*. 30 (1) Pp 87-88.

Nastis, A.S. and Malachek, J. C. (1981). Digestion and utilization of nutrients in Oak browse goats. *Journal of Animal Science*, 53: pp 283-290.

Onwuka, N. D. (1983). An appraisal of the cooking quality enhancement of cowpea by Kaun (Akanwu). *Journal of Food and Science Technology*. India 20: pp 198-201.

Ravhuhali, K. E., Ng'ambi, J. W., Norris, D. and Ayodele, V. I. (2011). The feeding value of four cowpea hay cultivars and effect of their supplementation on intake and digestibility of buffalo grass hay fed to Pedi goats. *Asian Journal of Animal and Veterinary Advances*, 6(9): 909–922.

Reddy, D. V. (2007). Applied nutrition livestock, poultry, human, pet, rabbit and laboratory animal nutrition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi. Pp121.

SAS. (2003). SAS/STAT. Guide for personal computer version, 6th Edition. Statistical Analysis System Institute, Inc. Cary, North Carolina, USA.

Smitha, P. P. A., Alagundagi, S. C. and Salakinkop, S. R. (2013). The anti-nutritional factors in forages - A review. Current Biotica 6(4): 516-526.