

SCREENING OF CHEMICAL COMPOSITIONS OF CRUDE WATER EXTRACT OF DIFFERENT CASSAVA VARIETIES

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ABSTRACT

Chemical composition of three sources of crude cassava water extract (CCWE) was evaluated in different varieties of cassava (MS6 Manihot Selection (local variety), TMS 30555 Tropical Manihot Selection (Improved variety) and Bulk (crude cassava water from cassava processing site). Crude cassava water extract from the pulp of cassava fresh roots was prepared and the chemical composition was determined in the analytical laboratory. The result of the analysis showed that, hydrocyanic acid (HCN) and with elements such as Calcium (Ca), Sodium (Na), Magnesium (Mg), Manganese (Mn), Iron (Fe), Sulphur (S), Copper (Cu) and Zinc (Zn). Nitrogen (N), Phosphorous (P) and Potassium (K) were found in the extract. The study showed that due to the presence of hydrocyanic acid in the extract, this waste found around the cassava processing sites possesses phytotoxic effects on weeds/vegetation in form of leaf decoloration (yellowing), wilting and eventually death. Crude cassava water extract showed a probable natural herbicide which can be used by the peasant farmers because it is environmental friendly and easily biodegradable into harmless compounds in the environment

KEY WORDS: *chemical compositions, crude cassava water extract, hydrocyanic acid, elements, natural herbicide*

INTRODUCTION

Concern has been raised over synthetic pesticides because they are known to be toxic to plants, animals, the farmers and hazardous to the environment. Synthetic pesticides are also expensive and many Nigerian farmers do not have formal education on how to handle these pesticides (Akobundu 1997; Fadayomi 1991; Ibro *et al.*, 2005). More so, dependence on pesticides has led to increase and unnecessary pest outbreaks due to inadvertent destruction of natural enemies of the pests, leading to pest resistance and emergence of secondary pests (Yudelma *et al.*, 1998).

There is a considerable public pressure to reduce dependence on pesticides due to environmental hazards (Conway, 1995; Backman, 1997). This has led to an increased interest in natural crop protection as an alternative, in order to achieve more environmental friendly pesticides. Pesticides with low cash input, readily available,

with a minimized environmental impact to manage pests (weeds, insects, nematodes etc) in crop production are been canvassed.

There is the need to encourage peasant farmers who dominate Nigerian sector of agribusiness to adopt utilization of natural pesticides to protect their crops and the environment. It is also desirable to develop crop protection tactics that provide the most economical use of pesticides. Any method that can replace synthetic herbicides usage in efficiency, without appreciable yield reduction will be adaptable in Nigerian agriculture (Salako, 2002).

Nigeria is one of the largest producers of cassava in the world. Processing of cassava crop is one of the major occupations (especially for women) in Nigeria where cassava is processed into gari, fufu “akpu” and cassava flour after fermentation. Meanwhile, at cassava processing sites during fermentation process, crude cassava water extract (effluents) are discharged as waste into rivers, streams, land and on vegetations. In essence, the crude cassava water extracts constitute unclean environment which breeds all sorts of social, health, ecological and environmental problems (Adesiyan, 2005).

Vegetation rarely grows along the path and around the vicinity where crude cassava water effluent is discharged. This suggests that the effluent is likely to possess phytotoxic potential. There is therefore, the need to evaluate the chemical composition of crude cassava water extract for phytotoxic effect on weed flora/vegetation.

MATERIALS AND METHODS

The study was carried out in Ijako – Owode in Sango Ota. Ijako –Owode is located between latitudes $6^{\circ} 35' N$ - $6^{\circ} 45' N$ and longitudes $2^{\circ} 55' E$ - $3^{\circ} 15' E$ (Oyesiku and Kadiri, 1992) It is located in Ado - Odo Ota Local Government Area of Ogun State in the tropical rain forest zone of south western, Nigeria.

Extracts of TMS 30555 (Improved genotype) was obtained from International Institute of Tropical Agriculture (IITA) Ibadan and MS6 otherwise called Idi – Ieru (local genotype) was obtained from Institute of Agricultural Research and Training (IAR&T) Moor Plantation, Ibadan while crude water (effluent) was obtained from cassava processing site in Ijako (Bulk) The field were prepared and laid out in a randomised complete block design (RCBD) with four replicates. The two cultivars (TMS 30555 and MS6) were grown till maturity before they were harvested.

Extraction of Crude Cassava Water Extracts (CCWE) from tubers of MS6 and TMS 30555 by grate - press method was described by Fayinminnu *et al.*, (2013).

Hydrocyanic acid from crude cassava water extract was determined using Spectrophotometric method of Bradbury *et al.*, (1999).

Calcium (Ca), Potassium (K) and Sodium (Na) minerals present in the crude cassava water extracts were determined using the method of Association of Official Analytical Chemists (AOAC, 1998), while Magnesium (Mg), Copper (Cu),

Manganese (Mn), Iron (Fe), and Zinc (Zn) contents were determined by AOAC (1999).

RESULTS AND DISCUSSIONS

Hydrocyanic acid (HCN) screening in the three different sources of CCWE is shown in Table1. The screening result showed highest hydrocyanic acid in the crude cassava water extract of MS6 over other sources, it was followed by Bulk source while TMS 30555 source recorded the lowest hydrocyanic acid. The analysis of chemical composition of different concentrations (mg/kg) of CCWE of different varieties is shown in Table 2, indicated that, the extracts (serial dilutions of 25-100%) contained hydrocyanic acid (HCN mg/kg) and other elements as shown in Table 3.

The MS6 crude cassava water extract from the pulp contained the highest value of hydrocyanic acid which ranged from 63.36 – 269.28mg/kg. It was followed by Bulk source with HCN value of 59.40 – 257.04mg/kg while the lowest HCN value was observed in TMS 30555 crude cassava water extract with 31.68 – 130.68mg/kg.

Table1. Hydrocyanic acid (HCN) Screening in three different sources of Crude cassava water extracts (CCWE)

Different Sources of CCWE	Hydrocyanic acid Level in CCWE
Bulk CCWE	+ + +
MS CCWE	+ + + +
TMS CCWE	+

+ + + + = Very High
 + + + = High
 + = Low

Table 2: Determination of active ingredient of different sources of Crude cassava water extracts (CCWE)

Sample CCWE	Abs. (510nm)	HCN mg/kg	%HCN=mg/kg/10,000
BULK			
25%	0.15	59.40	0.006
50%	0.33	130.68	0.0131
75%	0.48	190.08	0.019
100%	0.66	257.04	0.0257
MS6			
25%	0.16	63.36	0.00634
50%	0.33	130.68	0.0131
75%	0.53	210	0.021
100%	0.68	269.28	0.0269
TMS 30555			
25%	0.08	31.68	0.0032
50%	0.14	55.44	0.0055
75%	0.22	87.12	0.00871
100%	0.33	130.68	0.013

CCWE = Crude Cassava Water Extract; Abs. =Absorbance; nm= nanometer

Table 3: Elements present in different sources of Crude cassava water extracts (CCWE)

Elements (g/kg)	BULK	MS6	TMS 30555
Nitrogen (N)	3000	2800	3050
Calcium(Ca)	332	330	325
Potassium(K)	2930	2900	3100
Sodium (Na)	1800	1800	1790
Magnesium(Mg)	480	480	480
Iron(Fe)	38	37	36
Zinc(Zn)	63	63	63
Phosphorous(P)	670	670	700
Sulphur (S)	652	655	652
Manganese (Mn)	3.2	3.2	3.2
Copper (Cu)	0.3	0.3	0.3

The highest values of hydrocyanic acid (HCN) of MS6 can be related to its varietal influence over TMS 30555, an improved variety which contained lower HCN. This might be due to genetic manipulations during breeding. The high value of HCN in MS6 also showed the presence of toxic levels of cyanogenic glucosides due to high linamarin in the cassava (Cereda and Matos, 1996). The report of Tewe and Iyayi (1989) revealed that, the high cyanide value in CCWE from the pulp of MS6 made it to contain high toxins of HCN. Hydrocyanic acid in MS6 is likely to confer phytotoxicity.

However, water extract of TMS 30555 contained low value of HCN because it is an improved variety with low toxic levels of cyanogenic glucosides (linamarin) (Cereda and Matos, 1996).

The Bulk source of CCWE which was collected from cassava processing site showed comparable high level of HCN content as observed in MS6. This could be as a result of different sources (mixture) from which cassava processors obtained their tubers used for producing various commodities. Due to this mixture of cassava varieties, there is likely hood that the processors obtained some cassava varieties containing high level of HCN.

The observed high level of HCN in crude cassava water extracts could be responsible for decoloration, leaf burn, that are usually observed on the path of extracts that is discharged from the processing sites. Similar report had been given by Fayinminnu (1999; 2010).

The TMS 30555 variety showed high values in Nitrogen (N) 3050ppm, Phosphorus (P) 700ppm and Potassium (K) 3100g/kg over both MS6 (local variety) and Bulk source. The values of Magnesium (Mg) (480 g/kg), Zinc (Zn) (63g/kg), Manganese (Mn) (3.20 g/kg) and Copper (Cu) (0.30 g/kg) were the same for all CCWE. N, P and K were highest in the source of TMS 30555 crude cassava water extract because it is an improved cultivar while the higher concentrations of these elements in Bulk source could be adduced to the mixture of different cassava varieties.

This study showed that crude cassava water extract could be used as a biocide. This agrees with Putnam (1988) and Rice (1984) which suggested that hydrocyanic acid (HCN) is the phytotoxic ingredient in cassava water and has effects on weeds. This also agrees with the work of Ogundola and Liasu (2007) that cassava effluent interferes with photosynthesis and other physiological processes. Although, crude cassava water extract could be environmental friendly, without any persistence in the environment as the extract biodegrades quickly and become harmless in the environment (Fayinminnu, 2010).

Since hydrogen cyanide (HCN) is miscible with water, the average half - life and life time for particles in the atmosphere is estimated to be about 3.5 to 10 days and 5 to 15 days respectively (Balkanski *et al.*, 1993). Crude hydrocyanic acid from cassava water extracts, a natural product is considered fully biodegradable, less toxic and not enough to cause environmental pollution and also results into fewer environmental concerns (Tsao *et al.*, 2002). Therefore, there is a need for further studies on the phytotoxicity and residual activities in the environment of crude HCN from other different cassava varieties from their crude water extract as natural pesticide.

CONCLUSION

Due to the presence of HCN as main active ingredient in crude cassava water extracts from cassava varieties and its effects on flora/vegetation, it therefore showed that CCWE is a probable herbicide. From this study, it can be concluded that CCWE from cassava varieties classified as waste would perform well as a natural herbicide in crop production, since the HCN could act as a phytotoxic potential in controlling vegetation. This probable herbicide is readily available with little or no cost and can easily be used by the peasant farmers who could not afford the expensive synthetic herbicides.

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REFERENCES

- Adesiyun S.O. 2005. Man and his Biological Environment. University of Ibadan Press. 196pp.
- Akobundu L. O. 1997. Weed science development in Nigeria: Yesterday, Today and Tomorrow. *Nigerian Journal of Weed Science* 10: 61-70.
- AOAC 1998. Official Method of Analysis. Association of Official Analytical Chemist Washington, D.C.
- AOAC 1999. Official Method of Analysis. Association of Official Analytical Chemists Washington D.C.
- Balkanski B., V.S., Nelsen, B.A., Halkier, C.E. Olsen and B.L. Moller. 1993. The biosynthesis of cyanogenic glycosides in seedlings of cassava (*Manihot esculenta* Crantz). *Archives of Biochem. Biophys.* 292:141-150.
- Bradbury M.G., Egan S.M. Egan, Bradury J. H.. 1999. Determination of all forms of cyanogens in cassava roots and cassava products using picrate paper kits. *J. Sci. Food Agric*, 79, Pp.593 - 601.
- Cereda M.P., Matos M.C.Y.. 1996. Linamarin – The toxic compound of cassava. *Journal of Venomous Animals and Toxins* Vol. 2 (1) 6 -12.
- Fadayomi O. 1991. Weed management in Nigerian agriculture in the 90's. The chemical weed control option. *Nigerian Journal of Weed Science*. 4:79 – 85.
- Fayinminnu O.O. 1999. Comparative Toxicological Effect of a Post Emergence Herbicide, paraquat (gramoxone) and cassava waste water on the growth characteristics, food components and yield of cowpea (*Vigna unguiculata* (L) Walp). M.Sc Thesis, Department of Crop Protection and Environmental Biology University of Ibadan, Ibadan, Nigeria. 50pp.
- Fayinminnu O.O. 2010. Crude Cassava Water Extract as a natural post emergent herbicide and effects on growth, yield and food components of cowpea (*Vigna unguiculata* (L) Walp). Ph.D Thesis, Department of Crop Protection and Environmental Biology University of Ibadan, Ibadan, Nigeria. 225pp.
- Fayinminnu O.O., Fadina O.O, Adedapo A.A. 2013. Efficacy study of Bulk Source of Crude Cassava Water Extract as a post emergence in cowpea (*Vigna unguiculata* (L) Walp) production. *The Lesotho Journal of Agricultural Sciences* Vol. 3 No 1 pp 61-75.
- Ibro G., J. Lowenberg-DeBoer, Joan. 2005. Fulton. Market Value of Cowpea Protein Level and Cooking Time in Niger. Paper presented at and published during the International Edible Legume Conference in Durban, South Africa, April 17–21, 2005.
- Ogundola A.F., Liasu M.O. 2007. Herbicidal effects of effluent from processed cassava on growth performances of *Chromolaena odorata* weeds population. *African Journal of Biotechnology* Vol. 6(6), pp 685 – 690.
- Oyesiku O.O, Kadiri W., 1992. 'Ado Odo Ota Local Government Area". In: Onakomaya, S.O., O.O Oyesiku and F.J. Jegede (eds.). Ogun State on maps. Rex Charles Publication, Ibadan Pp 25.
- Putnam A. R. 1988. Use of allelochemicals as natural herbicides or pesticides. *Weed Tech.* 2: 510-518. In: M. An, J.Pratley and T.Haig (eds.) Allelopathy: from concept to reality. Environmental and Analytical Laboratories and Farrer Centre for Conservation Farming, Charles Sturt University, Wagga Wagga, NSW Pp 2650.
- Rice E.L. 1984 "Allelopathy." 2nd Ed. Academic Press, New York. 421pp.
- Salako E.A. 2002. Plant protein for the Resources poor farmers. Symposium paper Presented at the 30th Annual Conference of the Nigeria Society for Plant Protection (NSPP) Sept. 1-4, 2002. UNAAB, Abeokuta Ogun State Nigeria.
- Tewe O.O., Iyayi E.A.. 1989. Cyanogenic glycosides. In Toxicants of plant origin, Vol. 11, Glycosides. (ed). Cheeke, P.R. CRS Press. Pp 43-60.
- Tsao R., Chris J. P., J. R. Coats. 2002. Glucosinolate breakdown products as insect fumigants and their effect on carbon dioxide emission of insects. *BioMed Central (BMC) Ecol.* 2 (1):1-10pp.

- Yudelman M. A., Ratta A., Nygaard D.. 1998. Pest Management and Food Production: Looking to the future, Food, Agriculture and the Environment, Discussion Paper 25, IFPRI, USA

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