ISSN 0974 – 5211

Journal of Natural Products
Volume 5 (2012)
www.JournalofNaturalProducts.Com

Research Paper

Phytochemical Analysis and Heavy Metals Composition of Some Medicinal Plants Products in South African Markets

F. Mtunzi[1*], J. Nkwe[1], J. Modise[2], A. Sipamla[2], E. Dikio[1]
Chemistry Department[1], ICBT[2], Vaal University of Technology, Private Bag X021, Vanderbijlpark, 1900, South Africa
* Corresponding Author
(Received 04 July 2011; Revised 13 July-17 Sept. 2011; Accepted 17 September 2011)

ABSTRACT

Phytochemicals and heavy metals analysis of the six medicinal plant products, namely, Ibhubezi, Wonder Cure, Ingwe, Stametta, Tonic Life and Aloe Vera Gel were carried out with a view to assess their therapeutic values in ethnomedicine. The results showed that the bioactive compounds like alkaloids and saponins were present in all the medicinal plants products studied. Flavonoids were present in Ibhubezi and Ingwe, whilst terpenoids were found to be present in Ibhubezi only. Ingwe and Ibhubezi were the only two medicinal products which possess the anthraquinones. Ibhubezi was also found to be high with Fe content at 3.47±0.01ppm compared to Stametta with the lowest concentration of 0.007±0.03ppm. The Cu content was high in Wonder Cure and Ingwe compared to the other four medicinal plants products. Stametta was high in lead content and cadmium was found to be comparable among all the plants and it ranged between 0.80±0.31 and 0.81±0.33ppm. The zinc concentration was found to be high in wonder cure at 2.71±0.30ppm.

Keywords: Plant products; Phytochemical analysis; Atomic absorption spectrophotometer.

INTRODUCTION

Recently South African market has been inundated with introduction of many medicinal plants products, most of which their efficacy and toxicity have not been scientifically validated. These medicinal plants products are in most cases commonly known home remedies used to treat specific conditions or could be complex preparation often used for life threatening diseases (Cano and Volpato, 2004). They are usually constituted by plant parts such as leaves, flowers, tubers, bulbs and roots from different plant species in specific proportions based on the desired function of the concoction (Ndhala, et al., 2009; Pujol 1990; Rates, 2001). Their popularity is encouraged by the fact that most people are unable to afford medication from hospitals and pharmacies, whilst on the other hand medicinal plants products are

cheap and easy to access. The major problem with medicinal plants products is that the ingredients and their relative quantities are not listed on the product label, as required by South African Health Department Act 101 of 1965 and its amendments (Ndhala, et al., 2009). In addition to the problem, antibiotics are sometimes associated with adverse effects including hypersensitivity, immune-suppression and allergic reactions (Ahmad, et al., 1998). It is for these reasons that people resorted to herbal preparations for the treatment of their diseases and this together with the consumer demand have subsequently increased scientific interest in medicinal plants research (Khan, 2008).

Consumers use natural therapies mostly with the hope that plants products will sustain or bring back their health, although health care practitioners and health authorities do not believe in such products (Rates, 2001). With regard to quality, the hygiene and potential contamination of herbal products used in traditional medicines are a concern as they are sold on pavements and in markets where the materials are often exposed to sputum, urine and faeces, contravening the pharmaceutical manufacturing standards which are necessary for production and packaging of other medicines (Steenkamp, et al., 2006). The World Health Organization (WHO) in a number of resolutions emphasized the need to ensure the quality control of plant products by using modern techniques and applying suitable standards (Aliyu, 2008, WHO, 1992). It is therefore compelling to evaluate the composition of some metallic elements and phytochemicals in medicinal plants products because at elevated levels, these constituents can be dangerous and toxic (Somers, 1983; Schumacher, et al., 1991, Aleyu, et al., 2008). This study was designed to determine the phytochemicals and mineral contents of the selected medicinal plants products with a view to assess their therapeutic values and or safety in relation to their uses.

MATERIALS AND METHODS

***Plants Materials*:** Six commercial medicinal plants products, namely, Ingwe, Ibhubezi, Wonder Cure, Stametta, Tonic Life, Aloe Vera gel were randomly bought from herbal shops by voucher numbers Ingwe (BAT 05/10D), Stametta (DM12080110), Ibhubezi (IB0404), Aloe Vera (NC712996001A), Wonder Cure (WC001) and Tonic Life (TL001) around , Vereeniging, Gauteng Province, South Africa Their grades were commercial grade and they were identified by Mr Gunguluza, who is the herbalist at one of the herbal shops.

***Plants extracts*:** Medicinal plant products (250ml) were filtered through whatman No. 1 filter paper and freeze dried using Cuddon freeze dryer, FD 5.5, with 5,5kg ice condenser capacity, 0.55m^2, standard shelf freezing heating range between -25˚C and 70˚C and automatic vacuum pressure control. The dried material were weighed and used for phytochemical screening and Atomic absorption spectrophotometric analysis.

***Elemental analysis*:** Samples were investigated for elemental composition by using Atomic Absorption Spectrophotometer (AAS), Buck scientific model AGV 210. Appropriate working standard solutions were prepared for each element. The calibration curves were obtained for concentration versus absorbance. The data were statistically analyzed by using filtering of straight line by least square method. The trace elements comprising of iron, copper, lead, cadmium and zinc were determined according to the method of Shahidi, et al. (1999) with some small modifications.

Samples were sieved with 2mm rubber sieve and 2g of each of the freeze dried medicinal plant products were subjected to dry ashing in a well-cleaned porcelain crucible at 550˚C in a muffle furnace. The resultant ash was dissolved in 5ml of HNO_3/H_2O (1:1) and heated gently on hot plate until brown fumes disappeared. To the remaining material in each crucible, 5ml of deionized water was added and heated until colorless solution was obtained. The mineral solution in each crucible was transferred into a 100ml volumetric flask by filtration through a Whatman No. 1 filter paper and the volume was made to the mark with deionized water.

***Statistical Analysis*:** All determinations were replicated three times and results were reported as mean values ± standard deviation

Phytochemical Screening

Preliminary Screening of secondary metabolites

***Fat free sample*:** 2g of each sample was defatted with 100ml of diethyl ether using a soxhlet apparatus for 2h (Okwu and Josiah, 2006).

Alkaloids: 5g of the samples were weighed into 250ml beaker and 200ml of 20% acetic acid was added and covered to stand for 4hr. This was filtered and the extract was concentrated using a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitate was complete. The formation of the precipitate confirms the presence of alkaloids (Harborne, 1973).

***Flavonoids*:** A portion of the powdered medicinal plant product samples were separately heated with 10ml of ethyl acetate in a water bath for 3min. The mixtures were filtered and 4ml of each filtrate were shaken with 1ml of dilute ammonia solution. A yellow colour observation indicates the presence of flavonoids (Harborne, 1973).

***Saponins*:** 2ml of filtrate was added to 5ml of distilled water, shaken vigorously for 2 minutes and observed for frothing (Harbone, 1973).

***Terpenoids*:** 5ml of each medicinal plant product was mixed in 2ml of chloroform, and concentrated H_2SO_4 (3ml) was carefully added to form a layer. A reddish brown coloration of the interface show positive results for the presence of terpenoids (Harbone, 1973).

***Anthraquinones*:** Extract was separated on the TLC plate with appropriate solvent system. TLC plate was sprayed with a solution of 10ml methanol and 10g of potassium hydroxide (KOH). The presence of anthraquinones is indicated by the change of the original yellow brown color to purple color (Harborne, 1973).

RESULTS AND DISCUSSION

A total of six medicinal plants products from South Africa in Vereeniging, Gauteng Province were investigated. Table 1 shows the heavy metals composition of the six medicinal products and that Ibhubezi contained the highest concentration of Fe which is 3.47±0.01ppm. Fe is crucial for the building up of red corpuscles, which in turn are essential for formation of haemoglobin, the oxygen-carrying pigment in red blood cells. It is also used against anaemia, tuberculosis and disorder of growth (Claude and Paule, 1979). Zinc is found in all the medicinal plants products and is high in Wonder Cure at 2.71±0.30ppm. It is very important for nerve function, male fertility, stimulation of vitamins and formation of red and white corpuscles (Claude and Paule,

1979), healthy function of the heart and normal growth (Elizabeth, 1994). Copper was found in all the medicinal plants products, but it is high in Wonder Cure, 0.20±0.01ppm and 0.20±0.06ppm respectively. The function of Cu is to help in the absorption of iron. It is also important for the cellular defense, protection of the mucous membranes, anti anemic and for the formation of iron haemoglobin (Claude and Paule, 1979). Pb and Cd were both present in low amounts in all the medicinal plants products studied. Lead ranged from 0.56±0.22ppm and 0.66±0.21ppm. In high concentration, Pb can cause abnormal brain and nerve function and it tends to displace vital minerals like calcium in the body (Haider, 2004). Concentrations of Cd were comparable in all the medicinal plants products. High blood levels of Cd can cause acute renal failure, hardening of the arteries (atherosclerosis), and high blood pressure (Haider, 2004).

Phytochemical screening showed that all six medicinal products (Table 2) contain alkaloids and saponins. Alkaloids have anti-inlammatory effects (Liu, 2003) and hypoglycemic activities (Oliver, 1980; Cherian and Augusti, 1995). It has been reported by Rupasinghe et al. (2003), that saponins possess hypocholesterolemic and antidiabetic properties. Ibhubezi and Ingwe are the only two products that contain flavonoids. Flavonoids are potent water soluble antioxidants and free radical scavengers, which prevent oxidative cell damage and have strong anti cancer activity (Aliyu, 2008). Anthraquinones and terpenoids were observed in Ibhubezi and Ingwe only. According to Evans (1989), anthraquinones act on gastro intestinal tract to increase the peristalsis action. Terpenoids have been shown to decrease blood sugar level in animal studies (Luo, et al., 1999).

CONCLUSION

All above studied medicinal plant products contained safe levels of selected heavy metals and hence may have no adverse effects. The concentrations of copper, lead, cadmium and iron determined in our analysis are within acceptable limits set by the South African health department for these metals. The presence of saponins, terpenoids, flavonoids, anthraquinones and alkaloids could be attributed to the medicinal efficacy of these plant preparations.

REFERENCES

Aliyu, A.B., Musa A.M., Oshanimi J.A., Ibrahim H.A., Oyewale A.O., (2008): Phytochemical analyses and mineral elements composition of some medicinal plants of Northern Nigeria. *Nigr. Journ. Pharm. Sci*., 7:119-125.

Cano, J.H., Volpato, G., (2004): Herbal mixtures in the traditional medicine of Eastern Cuba. *J. Ethnopharmacol*., 90:293-316.

Cherian, S., Augusti K.T., (1995): Insulin sparing action of leucopelargonidin derivative isolated from Ficus bengalesis. *Linn. Indian J. Exp. Biol*., 33:608-611.

Claude, B., Paule, S., (1979): The Manual of Natural Living. 1st edition, Biddles Limited Guildford Surrey, pp.98.

Elizabeth, K., (1994): Immense help from nature's workshop. 1st edition, Elikaf Health Services Ltd., pp. 207.

Evans, W.M., (1989): Trease and Evans Pharmacognosy. The alden Press, Oxford, Great Britain, pp.832.

Farnsworth, N.R., (1994): The ethnopharmacology and drug development. In: Prance, G.T. (Ed.), Ethnobotany and the Search for New Drugs. Wiley, Chichester (Ciba Foundation Symposium 185), pp.42.

Farnsworth, N.O., (1994): The role of medicinal plants in drug development. In: Krogsgaar-Larsen, P., Christensen, S.B., Kofod, H. (Eds.), Natural Products and Drug Development. Balliere, Tindall and Cox, London, pp.8.

Harborne, J.B., (1973): Phytochemical Methods: A guide to modern techniques of plant analysis. Chapman and Hall Ltd. Ltd. London. pp.49.

Haider, S., Naithani, V., Barthwal, J., Kakkar, P., (2004): Heavy metal content in some therapeutically important medicinal plants. *Bull. Environ. Contam. Toxicol*., 72:119-127.

Liu, R.H., (2003): Health benefits of fruit and vegetables from addative and synergistic combinations of phytochemicals. *Am. J. Clin. Nutr*., 78: 517S-520S.

Luo, J., Cheung, J., Yevich, E., (1999): Novel terpenoid type quinines isolated from *Pycnanthu angolensis* of potential utility in the treatment of type-2 diabetes. *J. Pharmacol. Exp. Theraphy*. 288: 529-534.

Ndhala, A.R., G.I., Stafford, J.F., Finnie, Van Staden, J., (2009): *In vitro* pharmacological effects of manufactured herbal concoctions used in Kwazulu-Natal South Africa. *J, Ethnopharmacol.*, 122: 117-122.

Okwu, D.E., Josiah, C., (2006): Evaluation of the chemical composition of two Nigerian medicinal plants. Afr. J. Biotech., 5(4): 357-361.

Oliver, B., (1980): Oral hypoglycaemic plants in West Africa. *J. Ethnopharmacol*., 2: 119-127.

Pujol, J., (1990): The herbalist Handbook: African flora, medicinal plants. *Natur Africa*, Durban.

Rates, S.M.K., (2001): Plants as source of drugs. *Toxicon* 39: 603-613.

Rupasinghe, H.P., Jackson, C.J., Poysa, V., DiBerado, C., Bewely, J.D., Jenkinson, J., (2003): Soasapogenol A and B distribution in Soybean (Glycine Max L. Merr) in relation to seed physiology, genetic variability and growing location. *J. Agric. Food Chem.*, 51: 5888-5894.

Shahidi, F., Chavan, U.D., Bal, A.K., McKenzie, D.B., (1999): Chemical composition of beach pea (*Lathyrus maritimus L*.) plant parts. *Food Chem*., 64: 39-44.

Sharma, K.R., Agrawal M., Marshall M.F (2009): Heavy metals in vegetables collected from production and market sites of a tropical urban area in India. *Food Chem. Toxicol*., 47: 583-591.

Shumacher, H., Bosque, M.A., Domingo, J.L., Corbella, J., (1991): Dietary intake of lead and cadmium from foods in Tarragona Province, Spain. *Bull. Environ. Contaminants Toxicol*., 46: 320-328.

Somers, E., (1983): The toxic potential of trace metals in foods. *J. Food Sci*., 39: 215-217.

Steenkamp, P.A., Harding, N.M., Van Heerden, F.R., Van Wyk, B.E., (2006): Identification of atractyloside by LC-ESI-MS in alleged herbal poisoning. *Forensic Science International*, 163: 81-92.

World Health Organization, (1992): Expert Committee on Specification for Pharmaceutical Preparation Report, Geneva, *WHO Technical Report Series*, 823, pp. 44.

Table-1: Concentrations of mineral elements of the selected medicinal plants products.

Product name	Fe (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Zn (ppm)
Ibhubezi	3.47±0.01	0.19±0.01	0.56±0.22	0.81±0.33	1.51±0.43
Wonder cure	0.28±0.01	0.20±0.01	0.58±0.30	0.81±0.31	2.71±0.30
Ingwe	0.06±0.03	0.20±0.06	0.61±0.19	0.80±0.31	0.20±0.34
Stametta	0.007±0.03	0.19±0.04	0.66±0.21	0.80±0.31	0.24±0.10
Tonic Life	0.17±0.01	0.16±0.03	0.58±0.28	0.80±0.32	0.40±0.03
Aloe Vera Gel	0.019±0.01	0.13±0.05	0.55±0.34	0.80±0.33	0.40±0.03

Table-2: Qualitative estimation of secondary metabolites from the selected plants products.

Product name	Alkaloids	Anthraquinones	Flavonoids	Saponins	Terpenoids
Ibhubezi	+	+	+	-	+
Wonder cure	+	-	+	-	-
Ingwe	+	+	+	+	-
Stametta	+	-	+	-	-
Tonic Life	+	-	+	-	-
Aloe Vera Gel	+	-	+	-	-