Journal of Coastal Life Medicine

journal homepage: www.jclmm.com

Original article doi: 10.12980/JCLM.3.2015JCLM-2015-0025

Analysis of ash suspension obtained from *Piper aduncum* that claimed to cure cancer in Papua New Guinea

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ARTICLE INFO

Article history:
Received 4 May 2015
Received in revised form 3 Jun 2015
Accepted 28 Jun 2015
Available online 10 Jul 2015

Keywords:
Piper species
Piper aduncum salt
Ethnopharmacology
Traditional medicine
Morobe province
Cancer cure

ABSTRACT

Objective: To analyse the *Piper* ash suspension and the salts obtained from young and matured *P. aduncum* species.
Methods: Salts obtained by evaporating the ash filtrates of young and matured *Piper aduncum* shrubs and an ash suspension sample obtained from Busiga village were analysed for cations and anions.
Results: No organic part was found and only common inorganic cations and anions were present in all these samples. The Busiga sample, in addition, contained huge amounts of carbon ash (21.18 g/L). The essential mineral electrolyte content for the two salts was found to be 58.25% and 48.59% respectively. Details on electrical conductivity, Fourier transform infrared spectral and antimicrobial studies are discussed.
Conclusions: Though it has been a myth and mystery that people get cured from maladies, the rate of curing is possibly related to the presence of mineral electrolytes present in the suspension, and a rich change in the diet the patients adapt during such circumstances.

1. Introduction

People all around the world have learnt to effectively use the natural resources around them to improve the quality of lives, for example, adaptation of folk medicine and traditional healing through ethnobotanical or ethnomedicinal uses of medicinal plants and herbs[1]. A numerous book volumes, research reports and articles on plants and their medicinal values are available. Papua New Guinea (PNG) is a small island country in the Oceania continent with an approximate population of 7.5 millions, geographically having huge mountainous terrains and shares the border with Indonesia. PNG, prosperous in flora and fauna varieties, is culturally very rich with numerous traditional habits that are still being practiced and followed on a routine basis. *Piper aduncum* (*P. aduncum*), commonly known as spiked pepper, is shade-intolerant specie and is one amongst the thousand varieties in the shrub class of the Piperaceae family[2]. It was introduced to the PNG community from the South America, and it has invasive nature as well as the ability to make the drying rate of the soil faster. Indeed there were some concerns because of its interference with agriculture[3] , which resulted in serious impact on the economic, ecological, sociological, nutrient and botanical welfare in PNG[4], mainly because of the loss of primary forest with the replacement of indigenous vegetations. Barring these historical events that are still debatable for their pros and corns, the shrub now occupies most of the places in and around the Bulolo region of Morobe Province of PNG. In addition, it is very commonly found in Hawaii, Fiji, Vanuatu, Solomon Islands, Boreno, Mexico, Central America, Suriname, Cuba, Trinidad and Tobago, Jamaica and Costa Rica[3].

1.1. Medicinal advantages of P. aduncum

Extracts of *P. aduncum* are used as folk medicines in South America and as one of the major species it has been mentioned in several ethnopharmacological databases and possesses antifungal and antibacterial properties[5]. Around ten *Piper* species have been used for medicinal applications as well as to treat cancer and cancer-like symptoms, urological and dermatological problems, skin tumours, cramps, menstruation pain, ulcers, vaginal infections and even sorceries[6-8]. *P. aduncum* contains large numbers of bioactive organic compounds that include amide alkaloids, phenyl propanoids, lignans, neo-lignans, terpenes, steroids, flavonoids, alkenylphenols, piperolids and kawapyrones and some of them even exhibit insecticidal activity[9].

1.2. Importance of Piper species in PNG

Piper gibbilimbum, especially the juice obtained from the heated bark is used for treating cancer[10]. Extracts of various plant parts of *P. aduncum* like fresh barks, fruits, leaves, stems and roots are being consumed in three villages of Finschhafen (Sanangac, Sanzeng and Tongucboc) for curing tooth, head and stomach aches,

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fungal infections, insect bites (centipedes, bees and leeches) and scabies[3]. The essential "organic" constituents of the juice appear to be responsible for the beneficial properties. In PNG, medicinal knowledge involving indigenous plants is usually shared with close family members or associates. However, it appears that the medicinal properties of *Piper* have been learned over a period of time by trial and error. While the shrub is used for medicinal applications, and the stems, leaves, flowers and roots are used for household applications[11]. Some of the essential organic oils derived from *Piper* sp. have been shown to possess strong insecticidal, molluscicidal and antibacterial properties[12]. Analyses of the *Piper* ash suspension and the salts obtained from young and matured *P. aduncum* species are discussed in this paper.

2. Materials and methods

2.1. General protocol

All the reagents used throughout the study were of analytical grade. Deionized water [Merit-W4000 (UK) water still] was used throughout the analysis. pH and electrical conductivity studies were carried out as 1% salt solutions after filtering the residues, using TPS labchem-pH meter and TPS labchem-conductivity meter at (25 ± 0.3) °C and 24.1 °C respectively. Loss on ignition (LOI) was determined using a muffle furnace (S.E.M., Isai Pty. Ltd., Australia) provided with a digital control for setting the temperature. Inductively coupled plasma atomic emission spectroscopic analyses were carried out at National Analytical and Testing Services Limited, Unitech Campus, Lae, PNG. UV–visible spectra were recorded on a Varian 50 Bio UV–visible spectrophotometer for the two salts as water solutions. Chloride (Mohr titration), carbonate, bicarbonate, hydroxide (acid-base titrations) and sulphate (gravimetry) were determined using the reported procedures[13]. The salts of the *Piper* shrubs were mixed with potassium bromide (analytical grade) to prepare pellets and Fourier transform infrared (FTIR) spectra were recorded using JASCO FT/IR-4100 spectrophotometer. The procedure used for the antimicrobial studies was similar to the one described elsewhere[14]. Four human pathogens commonly found in PNG were selected for antimicrobial studies: *Bacillus cereus* and *Staphylococcus aureus* (Gram positive) and *Escherischia coli* and *Klebsiella pneumonia* (Gram negative).

2.2. Sampling and location

The dark black solution prepared from the *P. aduncum* ash was collected from Busiga village (latitude 6°41'53" S and longitude 147°45'48" E) of Finschhafen district, Morobe Province. Though the people only use the mature stems of *P. aduncum* for cancer cure preparations, both the matured and young stems were collected from Waramuli Area (latitude -7°10'30" and longitude 146°38'24" E) of Bulolo district, Morobe Province for the sake of comparison.

2.3. Black ash suspension obtained from Busiga

One litre of the black solution obtained from Busiga was filtered to get 21.18 g of black carbonaceous material and yellow-brown filtrate. The black material (2.000 1 g) was heated at 650 °C for 2 h to get 0.016 8 g (0.84%) of a white fluffy solid. The filtrate was evaporated to dryness and resulted in 0.641 8 g of brown sticky solid.

2.4. Salt preparation from stems obtained from Waramuli

The stem samples were cut into pieces of about 1 foot length, while each piece of the matured stem was cut into four quarters and air dried for 3 weeks, the young stems were dried as such to ensure complete loss of moisture. The young stem pieces (73.69 g) were burnt completely to get 4.595 3 g of greyish black ash. About 300 mL of distilled water was added, stirred thoroughly, filtered carefully, concentrated by distillation to about 50 mL and evaporated to get 1.028 2 g of air-stable white flaky solid. A similar procedure was adopted to prepare 2.004 5 g of air-stable white flaky solid using 169.37 g of matured stem.

3. Results

Table 1 provides data on ash-to-wood and salt-to-ash ratios for both young and matured *Piper* species.

Table 1

Availability of effective salt content in young and matured *Piper* species.

Description	*P. aduncum* (young)	*P. aduncum* (matured)
Weight of the wood (g)	73.690 0	169.370 0
Weight of the ash (g)	4.595 3	6.285 2
Weight of the salt–water soluble portion (g)	1.028 2	2.004 5
Ash-to-wood ratio (weight %)	6.24	3.71
Salt-to-ash ratio (weight %)	22.38	47.80

The analyses of the salts obtained from young and matured samples of *P. aduncum* shrubs and the ash and residue obtained from the black ash suspension are given in Table 2. Since the amount of ash and brown residue was very small (in mg range), anions could not be determined for the *P. aduncum* ash suspension obtained from Busiga village; however, qualitative analysis showed the presence of CO_3^{2-}, HCO_3^- and OH^- and absence of Cl^- and SO_4^{2-}. The white ash obtained from the LOI test of the carbon residue contains high percentages of calcium and phosphate. The electrical conductivity of the salts were determined as 1% solutions at 24.1 °C and they indicate the amount of electrolytes present in a solution and hence the salt.

Table 2

Comparison of properties between various samples of *P. aduncum* (cation and anion content reported in weight %).

Description	Busiga ash suspension		Bulolo stem samples	
	Ash from LOI test of the carbon residue	Brown sticky solid from yellow brown filtrate	Salt from young species	Salt from matured species
Na^+	1.71	2.73	0.25	0.16
K^+	4.85	22.07	23.85	31.35
Mg^{2+}	8.74	1.33	0.71	0.01
Ca^{2+}	31.72	4.84	0.76	0.08
Sr^{2+}	0.25	0.01	< 0.01	< 0.01
Ba^{2+}	0.53	0.01	< 0.01	< 0.01
B^{3+}	0.03	0.03	0.01	0.05
V	< 0.01	< 0.01	< 0.01	< 0.01
Mo	< 0.01	< 0.01	< 0.01	< 0.01
Mn	0.07	< 0.01	< 0.01	< 0.01
Fe	0.95	0.05	0.19	< 0.01
Cu	0.10	< 0.01	< 0.01	< 0.01
Zn	0.10	0.01	< 0.01	< 0.01
Cl^-	–	–	0.35	0.28
SO_4^{2-}	–	–	< 0.01	< 0.01
CO_3^{2-}	–	–	10.09	23.90
HCO_3^-	–	–	33.80	16.80
OH^-	–	–	0.70	1.14
PO_4^{3-}	26.80	0.80	< 0.01	< 0.01
SiO_2	0.65	0.21	0.83	0.30
pH	–	9.25[#]	10.00	10.60
Conductivity (μS/cm)	–	4 820[#]	9 520	12 860
Insolubles (%)	–	–	12.73	6.65
% Total mineral electrolytes (Na^+, K^+, Cl^- and HCO_3^-)	–	–	58.25	48.59

[#]: Data for the yellow brown filtrate.

FTIR spectra and data for the salts obtained from young and matured samples of *Piper* shrubs are given in Figure 1 and Table 3 respectively. The band patterns were found to be similar for matured as well as young *Piper* salts, indicating the presence of similar anions.

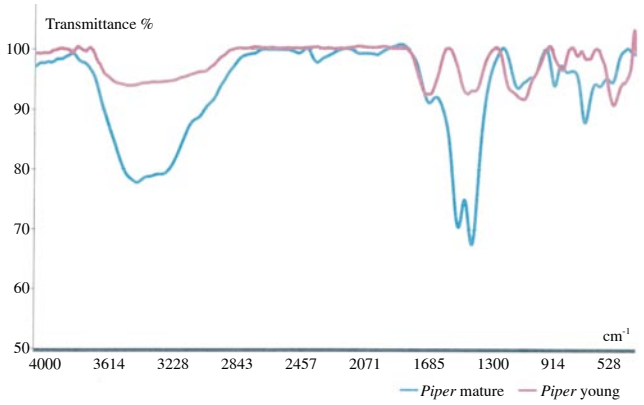

Figure 1. FTIR spectra of the salts obtained from young and mature *Piper* shrubs.

Table 3

FTIR spectral data for the salts obtained from *P. aduncum* shrubs.

Salt	IR (cm^{-1})
Young	1644 (vs), 1418 (vs), 1365 (s), 1065 (s), 840 (m), 710 (w), 528 (vs)
Matured	1640 (w), 1461 (s), 1386 (s), 1108 (w, br), 850 (w), 700 (m), 530 (vw)

vs: Very strong; s: Strong; m: Medium; w: Weak; vw: Very weak; br: Broad.

The effect of the two salts on *E. coli* is shown in Figure 2. Both the salts and the control sample (NaCl) exhibited similar effects–they did not inhibit the microbial growth, indicating that the salts have no effects on the chosen microbes.

Table 4 highlights the details of people who have been treated with the ash suspension for maladies in Busiga village between 2011 and 2014. As many as ten different maladies were treated using the suspension.

The mineral intake of both the solids was calculated and compared with the recommended daily intake (RDI) (Table 5). Carbon was found to be exceedingly high for the ash suspension.

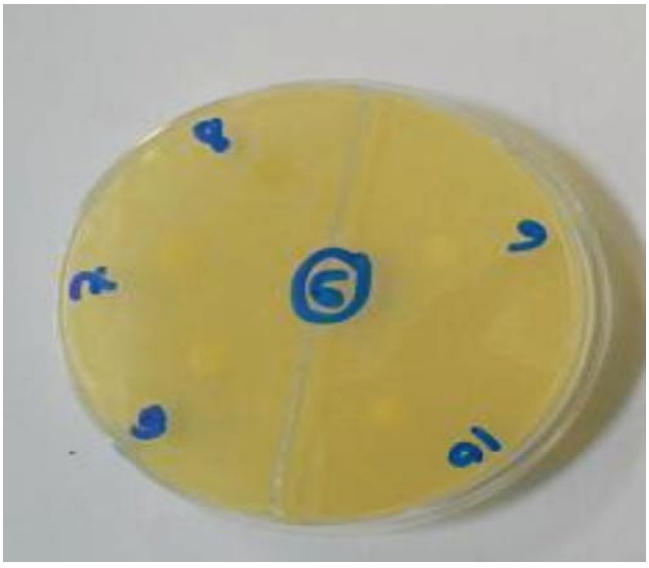

Figure 2. Plates showing the action of the two salt *solutions* on *E. coli* (6 & 8: *Piper* young salt; 7 & 9: *Piper* mature salt; 10: sodium chloride (control sample).

Table 4

Types of maladies cured with *P. aduncum* ash suspension in Busiga village during 2011–2014.

No.	Gender	Age	Patients cured (*n*)	Health problem
1	F	33-35	3	Breast cancer
2	F	35-40	2	Cervical cancer
3	F	38	1	Tumour in stomach
4	F	35-40	2	HIV/AIDS
5	M	40	1	Cirrhosis
6	M	47	1	Gonorrhoea
7	M	45	1	Heart related problems
8	M	40-45	2	Liver perforation
9	M	45-50	6	Flu
10	M	42	1	Oral cancer
Total			20	

F: Female; M: Male.

Table 5

Comparison of the minerals content (mg) on the basis of intake (500 mL) during the dosage days and the RDI values.

Cation	White fluffy solid	Brown sticky solid	Black ash suspension	Total	RDI	Comments
Na^{+}	1.52	8.76	–	10.28	2400	
K^{+}	4.31	70.82	–	75.13	3500	
Mg^{2+}	7.77	4.26	–	12.03	350	
Ca^{2+}	28.22	15.54	–	43.76	1000	
Sr^{2+}	0.22	0.04	–	0.26	5	
Ba^{2+}	0.47	0.04	–	0.51	14	
B^{3+}	0.03	0.10	–	0.13	< 20	Very safe
V	0.01	0.04	–	0.05	< 1.8	
Mo	0.01	0.04	–	0.05	0.075	
Mn	0.06	0.04	–	0.10	5	
Fe	0.85	0.16	–	1.01	15	
Cu	0.09	0.04	–	0.13	2	
Zn	0.09	0.04	–	0.13	15	
C	–	–	10501.04	10501.04	Not specified	Very high

4. Discussion

While the ash suspension obtained from Busiga was dark black, which upon filtration resulted in dark black solid, the laboratory preparation resulted in a more greyish ash from which white salt was obtained. This clearly indicated that: (1) the burning of the *Piper* stems at Busiga was done in an insufficient supply of oxygen (incomplete combustion) that aided in the formation of more carbon material; and (2) the filtration was not properly done and hence resulted in the ash suspension. The LOI test indicated that 99.16% of the black material was carbon. The pH and the electrical conductivity of the yellow-brown filtrate were found to be 9.25 and 4820 μS/cm, respectively. Based on this, on an average, the affected people consume about 32 g of the black carbonaceous material in a period of 6 days, which seems to be very high. Whether the consumption of carbon particles poses any health issue is still considered as an interesting topic for discussion. Two different views were put forward: a recent epidemiological study indicated that the carbon particles are directly associated with lung cancer, heart diseases and asthma[15]; and another study says that they have extremely low toxicities to humans and remain in the body tissues for an indefinite periods of time[16], which later could initiate other complications.

The burning of the stems was very smooth to yield the respective salts as white flaky solids. While the young species had high ash-to-wood ratio, the matured one had high salt-to-ash ratio implying that: (1) the majority of the young species was lost during the burning process; and (2) the majority of the ash produced from the matured species was water-soluble (Table 1).

4.1. Essential chemical elements

While a definite oxidation state for s- and p-block elements was given in Table 2, those of d-block elements were shown only in their atomic states because they usually exhibit variable oxidation states. SiO_2 is probably present as silicate because of the prevailing alkaline conditions (pH of 1% salt solutions: young 10.0 and matured 10.6), which are suitable for its formation. Chemical elements (cations) and anions given in Table 2 are classified into four categories[17]: (a) bulk elements (P as PO_4^{3-}); (b) macro-minerals or nutrients (Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^- and SO_4^{2-}); (c) trace elements or micro-nutrients (Fe, Cu and Zn); and (d) ultra-trace elements comprising of non-metals (B and Si) and metals (V, Mn and Mo). A clear difference in chemical constituents of young and matured salts could be seen thus indicating the need of certain specific minerals during the plant's particular growth period.

Hartemink noted that at the end of 23 months *Piper* species accumulated 222 kg N, 50 kg P, 686 kg K, 255 kg Ca, 75 kg Mg, and 24 kg of sulphur per hectare, of which more than half of the P, K, Ca and Mg were found in the stem part[18]. *Piper* accumulated large amounts of biomass and essential nutrients, particularly K. In the present study, this could be clearly correlated with: (a) the K content in young and matured salts containing 238 500 and 313 500 mg/kg respectively; (b) maximum K content compared to other essential elements; (c) minimum Mg and S contents in the matured salt; and (d) lowest PO_4^{3-} content in both the salts. In general, the ash suspension is alkaline in nature and hence the minerals like calcium, magnesium and iron would be removed in the insoluble portion during the filtration process[19]. This fact is further supported by the inductively coupled plasma data for the white ash obtained from water-insoluble carbonaceous material. Some of the species that play structural roles in the body like calcium and phosphate ions are available in the soluble portion, though in low quantities, and hence would play defensive action against dental caries[20]. While Na, Mg, Ca and Fe contents were decreased on moving from young to matured species, cations like K and B were increased and the remaining cations showed no change between the two species. These observations agree with those reported by Hartemink for the 70 °C-oven dried *P. aduncum* samples[18]. Sr was considered for determination in the present study because of its close resemblance in the size, chemical reactivity and properties with calcium[21]. Ammonium ion was absent in both the salts as evident from the absence of its characteristic pungent ammoniacal odour during heating of salts.

4.2. Types and amounts of anions

Usual anions reported for such traditional based plant salts in the past are halides (Cl^-, Br^-)[22], carbonate, bicarbonate, sulphate and very rarely phosphate and nitrate[23,24]. Depending on the pyrolytic conditions used for preparing the ash, the amounts of thermally labile anions like nitrate, carbonate and bicarbonate ions vary (Equations 1-4). Likewise, most of the phosphate salts are insoluble in nature[21]. However, in the present study, species like carbonate, bicarbonate, hydroxide, chloride, sulphate and phosphate have been detected (Table 2), though some of them are present in very low quantities. When the qualitative analysis was done using silver nitrate test[25], only curdy white precipitate was formed which dissolved completely in aqueous ammonia indicating the presence of only chloride and not bromide and iodide. The UV-visible spectra of the clear salt solutions indicated the absence of nitrate ion because no bands were observed at the expected regions of 300 and 190 nm, the latter one being assigned to $\pi^* \leftarrow \pi$ transition of the nitrate group[26]. To support further, when the solids were heated in a dry test tube over Bunsen flame, no reddish brown fumes due to nitrogen dioxide were noticed[25] (Equation 1). Hydroxide was found in both cases and this is probably due to the decomposition of carbonate according to Equations 2 and 3. The oxide ions are usually reactive in solution and hence they form hydroxide upon combining with water. Thus, in the salt obtained from both young and matured species, part of the carbonate ions was converted to oxide and then to hydroxide. Under the pyrolytic conditions, the bicarbonate ion probably got converted to carbonate ion (Equation 4) during the burning process.

$$2\,NO_3^- \rightarrow 2\,NO_2 + O^{2-} + \tfrac{1}{2}\,O_2 \quad ...(1)$$

$$CO_3^{2-} \rightarrow CO_2 + O^{2-} \quad ...(2)$$

$$O^{2-} + H_2O \rightarrow 2\,OH^- \quad ...(3)$$

$$2\,HCO_3^- \rightarrow CO_3^{2-} + H_2O + CO_2 \quad ...(4)$$

As expected, based on the solubility rules[21], the bicarbonate ions are present in relatively large amounts. Though sodium and potassium phosphates, and acid phosphates (*viz.* HPO_4^{2-} and $H_2PO_4^-$) are soluble in water, most of the other phosphates are insoluble thus making the PO_4^{3-} content in the salts very low (< 0.01%) because they were only derived from the water-soluble portion. Finally, in both cases, the sulphate content was found to be very low (< 0.01%) because its calcium salts are insoluble and thus probably got retained along with the water-insoluble portion. These arguments were further strengthened by the chemical composition data for the white fluffy solid (Table 3) obtained from the *water-insoluble* black carbonaceous material. Accordingly, calcium and phosphate are found to be present in large amounts, totalling to 58.52 %.

4.3. Electrical conductivity studies

The results were influenced according to the extent of solubility of the salts in water. Thus, the solubility of matured salt is high compared to the young salt; the former contained more dissolved minerals that conducted more electricity and hence larger conductivity values (12 860 vs. 9 520 µS/cm). For comparison, 1% NaCl solution has 16 860 µS/cm. The brown sticky solid derived from the Busiga black solution showed very low conductivity of 4 820 µS/cm compared to both the salt solutions, thus indicating the presence of lower amounts of soluble species in the solution.

4.4. FTIR spectra

In both the cases, a very broad band in the region 3 600 cm^{-1}-2 800 cm^{-1}, characteristic of moisture could be identified. This indicates that the salts are susceptible to absorbing moisture readily[14]. Majority of the bands were seen in both the salts thus indicating that they contain similar anionic constituents. The fingerprint bands clearly indicate the presence of IR-active polyatomic anions like bicarbonate, carbonate, sulphate and phosphate at varying levels[14]. In spite of overlapping bands, those due to carbonate ion are explicitly seen as strong bands: 1 418 and 1 365 cm^{-1} for the young salt and 1 461 and 1 386 cm^{-1} for the mature salt.

4.5. Antimicrobial studies of the Piper salts

Antimicrobial studies were carried out to check if the *Piper* salts (the inorganic part of *P. aduncum*) possess antimicrobial properties. Both the salts and the control sample (NaCl) showed no inhibition zone, in spite of using relatively higher concentration (1%). These four bacteria were not responding to the salts.

4.6. Does P. aduncum ash suspension contain anti-cancer properties?

The roots, leaves, seeds and fruits of *Piper* species were used for treating cancer by suitably extracting the bioactive constituents[8]. Some of the phenolic constituents, as mentioned earlier, are

present in the *Piper* species, which probably acts as antioxidants, free radical scavengers and metal chelators[27]. It is also reported that some phenolics are capable of acting as pro-oxidants that can induce oxidative stress by generating reactive oxygen species or by inhibiting antioxidant systems[28]; this gets accelerated in the presence of high concentrations of transition metal cations because of their tendency to exhibit variable oxidation states catalyse the pro-oxidant activity. But, fortunately, from the present study, it has been found that the concentrations of such metal ions are very low (Table 2) at least in the water-soluble portion of the ash (ash suspension). It is worthy to mention that such compounds are possible only if the "organic" plant extracts are used for curing and not the filtrate portion of the *Piper* species ash, which has suffered high temperature burning. The necessary bioactive phytochemical is unlikely to be present in the ash suspension.

According to a confidential practice, the stem of the matured *P. aduncum* shrub is cut, dried and burnt in an open fire to ashes. Then, about 50 g of ash was added to about 350 mL of water, stirred and filtered. Each time, fresh ash was added to fresh water and after filtration, the residues were discarded. This "dark black" suspension (500 mL) (rather than solution) is consumed as one dose. The doses are consumed three times on alternate days. This is done in Finschhafen district in a village called Busiga belonging to Morobe Province, as a traditional practice by a family, but kept confidential. Usually the Papua New Guineans who practice such traditional ways of curing diseases wouldn't reveal to anyone else. But the family is doing this as a help and service to the local community. The family inherited the knowledge from their ancestors that has been passed from generation to generations; the members are being respected by the people around the village.

According to the family, when the hospital or medical centre, after diagnosis, couldn't cure the patients or if the disease has advanced, or if the treatment is very expensive, then the patients around the village come to have medication from this family. After three dosages of the ash suspension, the people suffering from these problems (Table 4) were found to slowly gain energy, feel fresh and are all still surviving with good health.

Though the ash filtrate of *P. aduncum* are of plant origin, the organic parts of the plants, which have anti-cancer, anti-tumour and medicinal properties are burnt completely to ash from which the non-volatile inorganic salts are only obtained. The entire temperature range of open fire is about 300–900 °C depending on the proximity to the (plant) material being burnt[29]. These salts contain only the simple inorganic cations and anions and hence would not definitely contribute to the anti-cancer properties. Probably, when people consume the *P. aduncum* ash suspension, they are taking in the required inorganic mineral nutrients (either micro- or macro-), which play major roles in energy gaining mechanism and hence feel fresh and rejuvenated. This made them say that the solutions have anti-cancer properties; the solution acts as an electrolyte supplement drink that imparts some of the essential minerals like sodium, potassium, chloride and bicarbonate[30]. The cations like sodium and potassium are required to balance the electrical charges associated with negatively charged organic macromolecules in the cell[31]. The anions like chloride is the predominant anion that exists in the extracellular space, responsible for maintaining acid-base balances, transmitting nerve impulses and regulating the fluids in and out of body cells[32]. The bicarbonate ions play vital roles as components in the pH buffering system of the human body[33]. Though inorganic chemotherapeutic drugs like cisplatin are available, they function by coordinating to the guanine nitrogens of the rapidly replicating DNA strands, thus killing the cancerous cells. But, in the present case, the ash suspension consists of alkali and alkaline earth metals primarily, whose coordinating ability is poor and couldn't be compared to that of platinum and other transition metals[34].

Cancer is a multi-paced disease that results from environmental, chemical, physical, metabolic and other genetic factors that play direct as well as indirect roles in the stimulation and deterioration of cancers[27]. However, a limited Google search done to identify the correlation between the minerals uptake and anti-cancer properties resulted in vain. Finally, these special properties claimed by the people of Busiga village of Finschchafen district appear to be scientifically false, and therefore should be their cultural or indigenous view. However, the author has requested the family in Busiga village to clearly record the details of the patients who approach them for the treatment along with further follow-ups after the treatment is over.

4.7. Is it safe to consume the black ash suspension?

During the three alternate dosage days, the daily intake of a particular mineral present in white fluffy and brown sticky solids as well as daily intake of carbon are calculated using Equations 5-7, where x is the percentage of a mineral present in the white fluffy solid, y is the percentage of a mineral present in the brown sticky solid, 0.84% is the ash % present in carbon ash, 10.59 g is the amount of carbon ash present in 500 mL of *Piper* ash suspension, 99.16% is the total percentage of carbon present in the ash suspension, 320.9 mg/L is the amount of brown sticky solid present in 1 L of the ash suspension and 0.5 L is the volume of the ash suspension consumed per day.

$$\text{Mineral intake (mg) through white fluffy solid} = x\% \times 0.84\% \times 10.59\ \text{g} \times 1000\ \text{mg/g} \quad ...(5)$$

$$\text{Mineral intake (mg) through brown fluffy solid} = y\% \times 641.8\ \text{mg/L} \times 0.5\ \text{L} \quad ...(6)$$

$$\text{Carbon intake through black ash solution} = 99.16\% \times 10.59\ \text{g} \times 1000\ \text{mg/g} = 10501.04\ \text{mg} \quad ...(7)$$

The values in Table 5 clearly indicate that the black ash suspension is safe to drink, as the amounts of all the minerals consumed during the dosage days are less than the RDI values[35-37]. Though, carbon is not toxic, the level of carbon particles consumed appears to pose a risk, but needs to be established.

The ash suspension contains various elements from s-, p- and d-blocks and was found to be very safe for consumption. However, the carbon content was found to be exceedingly high (10501.04 mg, *i.e.* 10.5 g/day). It is really a myth and mystery and not the chemistry, that the people who consumed the ash suspension got cured from cancer and other maladies. The curing could probably be attributed to: (a) the increased intake of the required micro- and macro- nutrients; and (b) the people's suddenly changed food diet as a result of cancer and other overlapping factors. General aiding factors are consumption of anti-oxidant rich fruits and vegetables which are abundantly produced and available in Papua New Guinea, and this probably play major roles in preventing the cancer incidence as well as destroying cancerous cells from the body during the course of time. However, support comes from the studies on bamboo salts[38-40] that originated from Korea about 1000 years ago revealed the presence of ions of elements like Na, K, Ca, Mg, Mn, Fe, P, S, Zn, V, Mo, *etc*. The salts also contain certain amounts of charcoal (originated from the ash during preparation) which help in emitting body wastes. The bamboo salts were found to: (a) reduce gastric secretion; (b) increase the pH of gastric juice with the help of increased mineral contents; (c) increase the antioxidant effects by activating antioxidant enzymes and eliminating free radicals; and (d) increase anticancer effects in the cancer cells. Similarly, *Piper* ash suspension is being used to treat cancer and other maladies, and contains various elements (Table 2). The transition metal ions, in

particular, possess partially filled *d*-orbitals. They act as sources of or sinks for electrons, and hence exhibit variable oxidation states, thus increasing the antioxidant activities by cleaning the body and repairing the damaged cells.

Conflict of interest statement

I declare that I have no conflict of interest.

Acknowledgements

Thanks to Mr. Veisami (Bulolo University College, Bulolo, PNG) for assisting the visit to Busiga Village. The author is indebted to Mr. Onarong and his whole family for generously sharing the confidential information without which the research reported in this article would not have been possible. The hospitality by the villagers is greatly appreciated. Thanks are also to Ms. Dukaduka who estimated some of the anions during the final year student project, PNGUT Research Committee for the sponsorship and Department of Applied Sciences for the laboratory facilities.

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