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RESEARCH ARTICLE

Nutritional, phytochemical and cytotoxicity analyses of air potato *Dioscorea bulbifera* L. bulbils

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ABSTRACT

Air potato *Dioscorea bulbifera* L. is a crop that grows robustly and voluminously fruits but less utilized and adopted for consumption and cultivation. This investigation focused on the determination of the nutritional and phytochemical content and cytotoxicity of air potato *D. bulbifera* L. bulbils from Nueva Vizcaya and Quirino. Analyses revealed that the bulbils contained moisture of 17.52-26.84%, ash of 0.737-7.28gm/100gm, lipids of 0.1593-0.2032gm/100gm, the crude fiber of 0.29-2.7942, the protein of 1.0 mg/ml, and total carbohydrates of 0.8189-0.8721gm/100gm sample. These primary metabolites are essential for plant growth, development, defense against diseases and stress. These nutrients are vital for human nutrition and wellness as well. The presence of secondary metabolites such as anthraquinones, anthrones, coumarins, essential oils, fatty acids, flavonoids, phenols, steroids, triterpenes and tannins were also revealed in the phytochemical screening. These secondary metabolites are distinct characteristics of plants which when properly extracted can be a source of materials for breakthroughs in food development, nutraceuticals and pharmaceuticals. The bulbils were also found to be nontoxic. Thus, safe to be eaten. Geographical and environmental awareness, proper preparation and cooking management are must considerations to ensure its safety and economic value. With these capacities discovered, undeniably air potato is a cheap but rich source of material for food and medicine. These results are baseline data for bulbils found in the locality to be adopted to maximize the crop's produce for food processing, development, income generation and cultivation.

Introduction

The world is experiencing great transitions in all aspects of the economy today. The Philippines which relies mostly upon agriculture is not spared from it. Conversions of agricultural lands into commercial establishments, leisure parks and subdivisions are legally uncontrollable. These are the changes and difficulties embraced by farmers. To survive with economic change, farmers embarked on their farm undertakings into organically and chemically based farming. The inputs used eventually become detrimental to their health and the environment (1). With these, health-related concerns recourse into remedies from naturally growing unwanted folkloric products and laboratory analyzed medicinal plants. In many other ways, they look for crops that can sustain the drastic changes of climate but with a higher percentage of yield. Across the country, there are a lot of edible and medicinal plants which are on the verge of discovery. Nowadays, endemic plants which are neglected around are valued and given much attention for purposes of economic survival. In a way, a certain crop can answer these gaps. One of which is the less adopted but robustly bearing fruit vine known as air potato, *Dioscorea bulbifera* L.

D. bulbifera L. commonly known as air potato belongs to the Dioscoreaceae family. It is a herbaceous vine that grows out of the ground and bears fruits between the leaves. The fruits are like aerial tubers or bulbils. The stems can be round, slightly angled in

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cross- and counter-clockwise sections can grow up to 70 feet in length (2). This crop known from parts of tropical Asia and Africa is also widely reported in Latin Americas, West Indies, Southeastern United States and other parts of the world. Due to its ability to adapt and spread rapidly in a new climate, air potatoes were considered to be the most invasive plant species (3-7). It is found to be invasively growing in moist, mesic and hardwood forests, undisturbed areas, roadsides and most concentrated in canopy gaps. They are rarely found in pine forests but do not inhabit coastal areas due to the salty environment.

As this crop can be found in places described above, it was no wonder that they were found in temperate areas of Quirino (Q) and Nueva Vizcaya (NV) in Cagayan Valley (Region 02) Northern Luzon of the naturally diverse Philippines. They were found in the northern part of NV, in the towns of Diadi, Solano, and Bagabag. Kayapa, Bambang and Bayombong in the southern part. In Quirino province, they were found in the municipalities of Diffun and Aglipay. In the areas mentioned, the bulbils were dormant within summer until it wrinkles and sprouts to fruit again in June to December.

According to individuals who had encounter with aerial yam in the areas of study. It is bitter and pungent but edible sweet when boiled. It grows and fruits robustly with less care management. It is slimy greenish when peeled which gives a non-appealing appearance that led to the belief of being toxic. Although it bears fruit in volume, it was not cultivated intentionally because of no market value. There were no documented data about it either. It was only utilized as an alternate viand with the commercial potatoes(4, 6).

However, in Australia, air potatoes are detoxified to be edible. Bulbils are detoxified through baking and overnight leaching in running water to reduce bitterness and toxic compounds. Various sections of the yam have also been examined to be analgesic, diuretic, gastro-protective, antioxidant, anti-tumor, anti-inflammatory, antimicrobial, anti-fungal and anthelmintic. This tropical yam family requires little work and inputs once grown (7). It was also noted that it contains dietary nutrients, some secondary metabolites (8), and some mineral elements such as calcium, magnesium, phosphorus and magnesium (9-11).

The crop has been existing for a long period of time in the areas of study and has been known to produce a volume of aerial and ground tubers during its fruiting period. But there is less interest to cultivate and consume it due to toxicity beliefs, lack of innovation to be more palatable, and information about its contents. This crop can be a rich but cheap source of materials for food innovations and medicinal discoveries. Thus, this study was conceptualized to shed light on its contents and properties. The determined nutritional and phytochemical content and cytotoxicity led to the maximization and optimization of air potato produce from Nueva Vizcaya, Quirino and nearby provinces.

Materials and Methods

The present study was based on Descriptive Research. Data used were based on existing findings of the author and the documented laboratory analyses results were conducted by an accredited laboratory within the region (12, 16).

Research Environment

The samples were analyzed in an accredited laboratory which is recognized for performing nutritional content analysis, phytochemical screening and cytotoxicity assay. It is equipped with facilities that cater to the needs of the tests. Tests were conducted by qualified and certified analysts and technicians.

Research Instrument

A researcher modified questionnaire was used as the instrument in gathering the data needed from individuals with an experience of the bulbils. The laboratory instruments used were based on the laboratory protocols.

Data Gathering Procedure and Analyses

The accredited laboratory conducted the identification and analyses of the samples based on the laboratory protocols (12-14, 16-17). Qualitative analyses of the primary and secondary metabolites were only considered due to the financial limitation of the project and the availability of a lab that caters to the needed tests within the region. Results were validated by the farmers, agricultural experts and from literature. Below were the processes used in the study.

Determination of nutritional component,

Moisture content. Five (5) gms of fresh air potato bulbils were weighed in a weighted moisture box. Oven-dried at 100 to 105 ^{o}C and cooled in a desiccator. Repeatedly heated and cooled until it reached a constant weight.

Moisture (%) = (initial weight) – final weight) x 100/weight of the sample.....**(Eqn 1)**.

Total Ash content. One gram of air potato was weighed accurately into a crucible. The crucible was placed on a clay pipe triangle and heated over a low flame until all the sample was completely charred. Then it was heated in a muffle furnace for about 20 hrs at 150 ^{o}C. Then was cooled in a desiccator and weighed. To ensure that the content was in total ash, the crucible was again heated in the furnace for one hour, cooled and weighed. The process was repeated several times until two consecutive weights were the same and the ash turned into white.

Ash content (gm/100gm sample) =weight of ash x100/weight of sample taken.....
(Eqn. 2)

Total lipid content. Total lipid was determined by a modified method of Folch et al 1957. Five gms of the sample was suspended in 50 mL chloroform: methanol(2:2 v/v) mixture, homogenized thoroughly, and left to stand for three (3) days. Then the solution was filtered and centrifuged further. Through the Pasteur pipette, the upper layer of methanol was

removed and chloroform was evaporated by heating. The remaining particles were weighed and recorded as the amount of crude lipid.

Total Lipid (gm) = Weight of fresh sample –final weight.....**(Eqn. 3)**

T**otal crude fiber content.** Moisture free samples were put in a beaker and 200 mL of boiling 225 n sulfuric acid, H_2SO_4 was added. The mixture was boiled for boiled in 30 min. keeping the volume constant by adding water in frequent intervals. The mixture was then filtered through a muslin cloth and the residue was washed with hot water until free from acid. The sample was transferred to another beaker and 200 mL of 0.313N NaOH was added. After boiling for 30 min. keeping it in constant volume, the mixture was again filtered through another muslin cloth and residue washed with hot water to be free from alkali. Followed by washing with alcohol and ether. The samples were transferred to a crucible, dried overnight at 80-100 ^oC, and weighed (this was the We) in an electric balance. It was then again heated in a muffle furnace at 150 ^oC for 20 hrs cooled and weighed (this is the Wa) again. The difference in their weights (We-Wa) is the weight of the crude fiber.

Crude fiber (gm/100gm sample) = {100 – (moisture + fat)}xWe –Wa) .....**(Eqn. 4)**

Total Carbohydrate content.

Carbohydrate (gm/100gm sample) =100- {(moisture+fat + protein ash + crude fiber) gm/100gm} ..... **(Eqn.5)**

Secondary metabolites and cytotoxicity analyses, The bulbils were chopped into small pieces and air-dried for seven (7) days and oven-dried for three (3) days (five (5) hrs per day. After the drying period, the samples were powdered using a high-powered blender. The powdered samples were weighed and soaked in 100 ml ethanol for one day (24 hrs). Filtration and decantation followed for removal of precipitates and water bath for evaporation.

Phytochemical Screening was carried out for each plant extract to detect the secondary metabolites present. Each plant extract was spotted on marked and labeled TLC (thin layer chromatography) 7 x 4 cm, and was developed in the acetate-methanol (7:3) mixture in the developing chamber. The spots for a certain metabolite were visualized on the TLC plates and were exposed under UV light and a hot plate to check the separation of the different compounds.

For typical visualization of the secondary metabolites, vanillin-sulfuric acid reagents were utilized. This solution can determine the presence of Phenols, Steroids, Triterpenes and essential oils. Methanolic potassium hydroxide was used to test Anthraquinones, coumarins and anthrones while phenolics compounds and tannins were detected through the use of potassium ferricyanide-ferric chloride reagent. Dragendorff's reagent was used to spot alkaloids and Antimony (III) chloride was used to detect the presence of flavonoids.

The air potato bulbils were air-dried for one week and oven-dried for 3 days (of 5 hrs in a day). It was extracted with ethanol and the extract underwent a water bath until it turned into a paste texture. Then subjected to Brine Shrimp Lethality Assay (BSLA).

For the BSLA. Artificial seawater was prepared by dissolving 3.8 gm of sea/rock salt in 100 mL of distilled water for hatching the shrimp eggs. The artificial seawater was put in a standard size Petri dish (hatching chamber) with a partition for dark (covered) and light areas. Shrimp eggs were added into the dark side of the chamber while the other side (light) will attract the hatched shrimp. Two days were allowed for the shrimp to hatch and mature as nauplii (larva). After two days, when the shrimp larvae are ready, 1 ml (1000 ppm, 500 ppm, 250 ppm, 125 ppm and 62.5 ppm) of the plant extract was added to every 15 well plates using 24 well plates, and 10 brine shrimps were introduced into each well. This was done in triplicate. Thus, there were a total of 30 shrimps per dilution. The well plates were left uncovered under the light/lamp. The number of surviving shrimps were counted and recorded after 24 hrs. Using Probit Analysis, the lethality concentration (LC) was assessed at 95% confidence intervals. LC of less than 1000 ppm was considered potent (active). As mentioned by Meyer *et al*, (1982), an LC value of less than 1000 ppm is toxic while an LC value of greater than 1000 ppm is non-toxic. The mean mortality was also calculated by adding the number of dead nauplii per replicate divided by 3 (replicate). This is to ensure that the death (mortality) of the nauplii is attributed to the bioactive compounds present in the plant extracts (16, 17). This test determined the mortality rate of brine shrimp at various concentrations (62.5, 125, 250, 500 and 1000 ppm) and time intervals (3 hrs, 6 hrs, 18 hrs, 21 hrs and 24 hrs). The crude extract is toxic if it has an LC50 value less than 1000 ppm while non-toxic if it is greater than 1000 ppm (Table 3).

Table 3. Cytotoxicity assay of air potato bulbils

	Mean Mortality Rate (Air Potato Extract)							
Concentration	**3hrs**	**6hrs**	**9hrs**	**12hrs**	**15hrs**	**18hrs**	**21hrs**	**24hrs**
1000 ppm	0	0	0	0	0	0	0.67	0.67
500 ppm	0	0	0	0	0	0	0.33	0.33
250 ppm	0	0	0	0	0	0	0	0
125 ppm	0	0	0	0	0	0	0	0
62.5 ppm	0	0	0	0	0	0	0	0
LC_{50} (62,622.9 @ 21 and 24 hrs)	Non – toxic	Non-toxic	Non - toxic	Non - toxic	Non - toxic	Non - toxic	Non - toxic	Non - toxic

Results and Discussion

Nutritional Contents

Air potato bulbils contained nutrients and minerals which are physiologically important. Table 1 shows the nutritional content of the air potato bulbils. Based

on the nutritional composition analyses, air potato bulbils had a moisture content of 17.52 % from Q and 26.84 % from NV. The NV sample showed a comparatively higher percentage of moisture. This finding affirmed that aerial yam cultivars had moisture content that ranges from 6.99 to 7.12 %. About the same 17.69 % moisture content from Uddiawan, Solano, NV which was approximately 3.55 to 66.57 % if bulbils were fresh dry. As in many other yam plants, humidity is the highest percentage (9-12). The water content of raw material plays a crucial role in the physical and chemical stability of the ingredients in the pharmaceutical preparation of substances. It affects the consistency of the finished product, processability, storage, accuracy and

Table 1. Nutritional component of air potato bulbils from Nueva Vizcaya and Quirino

Samples from	Moisture Content (%)	Total Ash Content (gm/100 gm sample)	Total Lipid (gm)	Crude Fiber (gm/100 gm sample)	Total Protein (mg/ml)	Total Carbohydrates Estimation (gm/100gm sample)
Nueva Vizcaya	26.84	0.728	0.1593	0.29	1.0	0.8189
Quirino	17.52	0.737	0.2032	2.7942	1.0	0.8721

analytical indicators for calculations. This content is important to human nutrition whereby water is essential for metabolism and health.

The total ash content of the samples ranges from 0.728 (NV) to 0.737 (Q). The sample from Q had a comparatively higher content of ash than in NV. The higher content of ash in an extract was dependent on its environment and maturity. The ash content of raw material is a measure of the total amount of minerals and the particular inorganic components present in a portion of food such as Ca, Na, K and Cl. The determination of the ash and mineral content of food is essential for nutritional labeling, consistency, microbiological stability, nutrition and food processing. The presence of ash in the bulbils had shown that minerals are present in this marvelous plant. Therefore, a good food source for human consumption (13-19).

The total lipid content of the bulbils ranged from 0.1593 (NV) to 0.2032 (Q). This presence indicated that the samples contained fats that are essential source of energy for the human diet (20). The existence of lipid components in a product plays a key role in deciding the overall physical characteristics of foods such as flavor, texture, palate and appearance. However, over-consumption of such lipid components can be harmful to one's health (21-23).

As far as the raw fiber content is concerned, it was comparatively higher in the Quirino sample (2.7942) than in NV (0.29). The high content of fiber is due maturity of plants wherein as the plant matures, fiber content increases. Samples from Quirino were matured than the samples in Nueva Vizcaya. However, this proved significantly that there was a nutrient component for both samples. This primary material is also used in plants to calculate the volume of indigestible cellulose, pentosan, lignin and other food ingredients. Having fibrous foods in one diet increases gastrointestinal efficiency. It also prevents constipation, colon cancer, cardiovascular disease and hyperlipidemia. It increases the glycemic response as well. It is also known to reduce the occurrence of obesity, plasma cholesterol and regulate weight.

Air potato bulbils from both provinces positively exhibited 1.0 mg/ml of protein. This was a good indicator of food nutrients since potatoes are considered to be an excellent source of vitamins and minerals. This was affirmed by the study which included important non-essential amino acids in the fermentation of air potatoes. The protein content ranged from 0.70 to 10.81 mg/gm. Potato proteins are known to have high levels of amino acids with hydrophobic functional groups. These characteristics were important for the production of food products even if dietary proteins are not all the same due to their combinations, especially in physiological processes.

The samples included exhibited 0.8189 (NV) and 0.8721 gm/100 gm sample (Q) for the total carbohydrate estimate. It should be noted that Quirino air potato bulbils had more or less the same NV content. Plant species with underground stem tubers and roots store carbohydrates in a variety of contents. 71.46 % of carbohydrates are found in unfermented air potatoes. Affirming that underground storage organs, such as potatoes, have the ability to accumulate a large amount of triacylglycerol (TAG). This indicated that tuber crops such as *D. bulbifera* L. have a high energy capacity. Wild yams provide all food nutrients within the recorded and appropriate root values and tuber crops. Thus, in nutrition and economic aspect, it is highly recommended to utilize the air potato high yield capacity.

These central metabolites which include vitamins, carbohydrates, proteins lipids, ash, fiber, moisture which are required for the growth and maintenance of cellular functions were found in the samples. They are important constituents of daily diet both for plants and animals and are involved in maintaining normal and essential physiological processes such as proper growth, development and reproduction (24, 25). But deficiency of one constituent may lead to abnormalities in the body. These nutritional values suggested that air potatoes must be explored more for food product sources.

Phytochemical Contents

The phytochemical screening of both samples revealed the presence of the same secondary metabolites. These were byproducts of primary metabolism synthesized after the growth phase had been completed for the ecology and physiology of the cell. These substances increase the fitness of the producing organisms and decrease the fitness of the surrounding organism. Some of which are poisonous to animals, plants and microorganisms.

In developing nations like the Philippines, natural plants with medicinal potentials are on the verge of exploration. Nutraceuticals and

pharmaceuticals are at par for health care sector improvements for diseases managements and food innovations. Good nutrition affects man's ability to sustain his well-being, thus, must take in nutritious

Table 2. Secondary Metabolites present in air potato bulbils from Nueva Vizcaya and Quirino

Samples from	Secondary metabolites present
Nueva Vizcaya	Anthrones, anthraquinones, coumarins, essential oils, fatty acids, flavonoids, phenols, steroids, tannins, triterpenes
Quirino	

balanced natural food products. The following were the secondary metabolite contents of the bulbils with the corresponding importance and uses (Table 2).

Anthrones were found in potato aerial bulbils from both samples considered in this study. These metabolites are used for cellulose assay, colorimetric determination of carbohydrates and a laxative. There are high-level plants with a high content of this substance and lower amounts in other types of vegetables and herbs. Anthraquinones on the other hand is from the largest group of naturally occurring quinone pigments. They occur in plants as hydroxylated, methylated or carboxylated derivates of anthraquinones, anthrones, anthral or dianthrone. They are commonly used as dyes and cathartics or purgatives. Its presence proved that the crop can be a big source of the material.

The samples considered in this analysis contained essential oils. Essential oils are known to have anti-depressants, relaxants, detoxifiers, antibacterial and anti-viral effects. They are known to be natural, safe and cost-effective for a variety of health concerns. In 2017, Neuro Endocrinology Letters suggested that some flowers and plants with essential oils can help balance hormone levels, increase immunity, fight infections, promote digestion and improve brain functions. However, the consistency of essential oil products can be affected if the harvesting and processing methods do not comply with the requirements. When properly prepared, extracts from the bulbils can be cheaper but of the quality source of essential oils.

Coumarins were found in the samples. These phytochemicals are widely distributed in nature. It is emitted by plants as a chemical defense against predators. Are used as synthetic coagulants as enzymatic inhibitory agents in neurodegenerative diseases. Although its efficacy depends upon the pattern of substitution (26, 27). This metabolite was found in the bulbils under study, thus a potential counterpart source.

Fatty acids (FA) were determined in the air potato bulbils. These can be an alternative source for the growing demand for fatty acids. Since FA from diet influences people's health condition which can deteriorate or ameliorate the evolution of some diseases. Scientists are on the exploration of Biomarkers that indicate the progression of a disease in which fatty acid is eyed to be a potential. This metabolite if present in diets plays an important role in preventing cardiovascular diseases because of its anti-inflammatory character.

Flavonoids naturally occur in plants and positively present in the bulbils. This metabolite occurred in a wide range of colors from pale yellow to blue which indicates antioxidant properties. It protects the walls of the vascular system by scavenging free radicals which decreases the risk for heart diseases and prevents inflammation, tumor growth, osteoporosis and viral infections. Nevertheless, its anti-oxidant potential and specific effect in promoting human health is influenced by the chemical, physical and structural properties (28-30). The bulbils in the study exhibited a pale yellowish coloring when peeled. This was an affirmation that it contained flavonoids.

Air potato bulbils contained the steroid, *diosgenin* used in commercial synthetic steroidal hormones. In India (Ayurvedic medicine) it is used to treat diarrhea, sore throats and jaundice. Other therapeutic claimed to have anti-diabetic potentials. On the other hand, steroidal glycosides are known as cardiac glycosides, cardenolides and bufadienolides have known effects on the heart muscles and adrenaline booster for athletes. It was also found out that bulbils were rich in allantoin (20.38 mg/gm)(31).

Tannins were also present in the sample bulbils. This substance is used in pharmaceutical preparations because of its astringent action and potential for cytotoxic and antineoplastic agents and as a plant oxidative defense. Polyphenols are structurally close to tannins found in bulbils. References suggested that they were used as additives in the leather industry; as antioxidants in processed foods; certain phenolic compounds are chemopreventive to cancer and encourage healthy ageing. In experiments using fermentation, unfermented air potatoes had the highest levels of phenol (1.16 mg/gm), tannin (2.50 mg/gm), and saponin (2.57 mg/gm). This bulbil content supported the need for bioactive compounds in air potatoes to be further explored and used as additives to food products.

The bulbils under research included turpentines and particularly norclerodane diterpenoids. These secondary metabolites represent the largest class of natural products that are abundant in higher plants. Many terpenoids exist as glycosides or as glycosyl ester. They are commercially important as the basis for natural perfumes, spices and flavorings in the food industry (32).

Plants synthesized secondary metabolites have been used as natural protection against insects, nematodes, bacteria, fungi and viruses. They are often used for the reproduction of plants and the dissemination of species; as alarm signals and as pollinators with their aesthetic hues. These metabolites were present in humans who were consuming vegetables and bioactive effects can be either beneficial or hazardous. Thus, a comprehensive understanding of their bioactivity contributes significantly to the safety and well-being of consumers and medicinal applications. The development of secondary metabolites in plants may

also be due to regulated factors. The type, number and quantity of chemical substances present in medicinal plants depend on the soil, environment and season, the quality and density of the sun, the length of the day the stage of growth and other characteristics of the plant (33). Potato tubers contain higher concentrations of saponin, cardiac glycosides, flavonoids, sugar-reducing terpenoids and tannins.

These findings proved that *D. bulbifera* L. bulbils in the locale were cheap but excellent source of bioactive compounds for health-promoting properties (34) and bases of production for novel potent drugs (35, 36) and food sources if properly cultivated and prepared for livelihood and income generation.

Cytotoxicity Test

Cytotoxicity tests for plants for consumption and health benefits possibilities are valuable initial measures to refute the belief. The minimum to no toxicity content of plant extracts is important for the effective production of pharmaceutical products and food preparations. These tests are crucial for the determination of the acceptability parameters, particularly for plants that are already considered to be edible for a period of time. Dose level is the most considered toxicity parameter. It is based on the difference between the therapeutic and the toxic extract for a compound (37). Lethal concentration, LC50, refers to the concentration of a chemical in air or water. However, other exposure durations can apply depending on particular laws and protocols (38). The LC50 value is the concentration of the chemical that kills 50 % of the test animals during observation.

The concentration of extracts with brine shrimp was observed in this analysis. Both temperature and salinity influence the survival and development of shrimp, with a more pronounced temperature effect. Notably, the presence of alkaloids, oxalates and saponins at high concentrations in yams leads to being poisonous and inedible. Scientifically, these metabolites were not found in the samples, thus leading to their being edible and non-poisonous. Obviously, the way in which this yam species is cooked will reduce its characteristics of being poisonous and inedible.

Table 3 shows that air potato bulbil extracts were non-toxic. The condition that the crude extract is toxic if it has an LC50 value of less than 1000 ppm and is non-toxic if it is greater than 1000 ppm was observed thoroughly. In this study, the value was 62,622.9. This indicated that the *D. bulbifera* L. bulbils extract was not poisonous within the hrs the brine shrimps were tested. But it reached the condition whereby 50 % of the shrimps can no longer withstand the toxin level of the extract after 3 hrs until 18 hrs from 62.5 to 1000 ppm. With the various time observed within 24 hrs, only 0.33 to 0.67 mortality rates were observed within 21 to 24 hrs. The sample bulbils collected in NV were no longer tested for cytotoxicity since according to lab experts, agriculture officers and individuals, consumption of the bulbils within the area of study is a validation that it was not toxic. This result nullified the beliefs of the farmers that the bulbils were toxic. This discovery ensured that the bulbils were safe to be eaten with proper care management and food preparation. It should be stressed that environmental, genotypic and analytical differences may have played a major role in the differences in results; variety and geographical variations are equally or more important factors in deciding the quality of potatoes than the farming method for safety (39, 41-44).

Conclusion

Air potato bulbils found within the area of study contained nutritional components such as moisture, ash, lipid, fiber, protein and carbohydrates. These contents are beneficial to humans consumed from natural products. The bulbils also positively exhibited the presence of the secondary metabolites specifically anthrones, anthraquinones, coumarins, essential oils, fatty acids, flavonoids, phenols, steroids, tannins and triterpenes. These are potential for medicinal breakthroughs in health care services enhancements and food developments. The bulbils were found to be not toxic. This established the fact that it is safe to be eaten (Fig. 1).

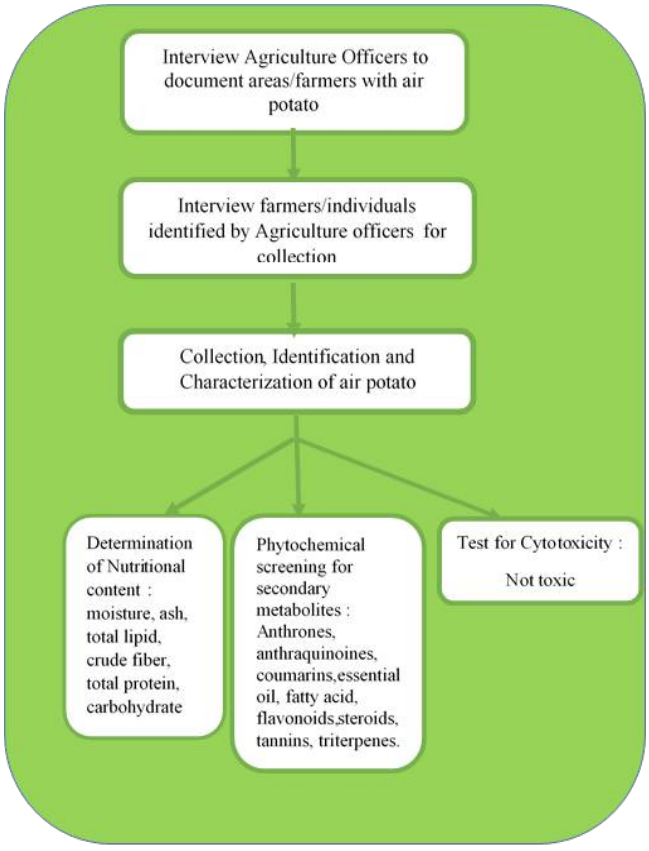

Fig. 1. Conceptual Process and result of the study.

These results indicated significant findings that air potato, *D. bulbifera* L., must be cultivated and adopted. This indigenous crop is a rich and cheap alternative source of food nutrients for human consumption. It can be an answer to farmers' alternative crop for additional income generation

through product development and be in its humblest way aid in the world's food crisis.

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Authors' contributions

RVG conceived, coordinated all the protocols for the conduct of the laboratory activities which were performed by the accredited laboratory, analysed the data and completed the final manuscript.

Conflict of interests

The author does not have any conflict of interests to declare.

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