

## PHYTOCHEMICAL SCREENING, ANTIOXIDANT ACTIVITY AND ALCOHOL CONTENTS OF ARDISIA ELLIPTICATHUNB BERRIES

RUBY LYN V. GUTIERREZ<sup>1</sup>, MILA T. BENABISE<sup>2</sup> and NUR E. AGUSTIN<sup>3</sup>

<sup>1,2</sup> College of Agriculture, Forestry and Engineering, Quirino State University, Diffun, Quirino, Philippines.

<sup>3</sup> Quirino Young Entrepreneurs Association.

Email: blueruby25@yahoo.co.nz, mtbenabise@gmail.com,

### Abstract

Tropical fruits are in the emergence of innovations for livelihood and commercial development. This endeavor can be realized with *Ardisia elliptica*, AE. This underutilized shrub grows and bears fruits robustly with less management and costs. A crop with a high potential for value-adding can increase Filipino household income when its potential is maximized for consumption and production. This study focused on the determination of the presence of phytonutrients, antioxidant properties and alcohol contents of *Ardisia elliptica*, AE, berries when the extract is mixed with other tropical fruits and made into wines. Samples of AE were taken from Quirino State University- Diffun campus and subjected to laboratory analyses. The phytochemical screening of the AE crude extract AE detected the presence of anthocyanins, flavonoids, quinones and tannins. Wines made from AE extract with other tropical fruits like bignay and duhat detected three more phytochemical nutrients such as phenols, saponins, and terpenoids. Antioxidant analyses through 1, 1-Diphenyl-2-picryl hydroxyl (DPPH) quenching assay also revealed an 89.80% and 88.87% antioxidant activity for AE with duhat wine and AE with bignay wine, respectively. Since the wines had higher value of inhibition percent, the greater is its antioxidant activity. These results proved that AE can greatly contribute to the wellness of its consumers. The test further showed that *ardisia* wine with duhat had an 11.29% alcohol while *ardisia* with bignay wine had an 11.72 % alcohol. This means that *Ardisia elliptica* with duhat has a low alcohol content. Phytonutrients in fruits provide desirable health benefits that can have breakthroughs in nutraceuticals and pharmaceuticals. These results showed the enormous capability and characteristics of *Ardisia elliptica* berries as a potentially rich cheap source of raw material for further exploration and development of alternatives to commercially available fruit products and as a basis for the enhancement and conservation of its biodiversity.

**Keywords:** Antioxidant, *Ardisia Elliptica*, Phytochemical, Bignay and Duhat

### INTRODUCTION

The Philippines is endowed with rich and nutritious high-value tropical fruits. They are grown purposely for family consumption and in excess for commercialization. But most fruits are wasted due to low-cost selling, less to no available market due to unknown contents, fear of its toxicity, and lack of knowledge on how to maximize the produce to mention the competition with commercially available fruit juices.

*Ardisia elliptica*, AE *Thunbis* one of the very robustly fruiting tropical shrubs. It is also commonly called a shoebutton from the order of the *Ericales* and *Myrsinacea* families (Wunderlineet al., 2022).

The plant usually grows manageably in tropical sites. It is shade tolerant, but can also succeed in full sun. It prefers moist, wet, fertile clay soil. It is often grown as an ornament but it is considered to be invasive in many places in the United States and has been declared a noxious weed in Hawaii. This shrub may grow as much as 1 meter in the first year as a sprout, but

seedlings and established shrubs grow slowly from 25 cm to 50 cm a year in height. The plant can flower and produce seed within 2 to 4 years from seed with a likely lifespan of between 10 to 25 years (tropical.theferns.info. 2022-09-17).

The leaves are elliptic to elliptic-obovate, leathery and alternate. The petals are light pink. The fruit looks like a berry but is a round drupe (like a peach fruit, with a single seed), about ¼ inch across. The fruits are initially white and then change from red to purple-black. It has a slightly sour taste with a hint of starch but lacks flavor (<http://www.asianplant.net/>). It turns from red to a deep purple-black as it matures (Francis, 2000). However, the taste of the fruit is bland and astringent which makes the fruit not appealing to eat as fresh.

Medicinally, the roots are used during childbirth (Plants of Southeast Asia), and a decoction of the leaves is used in retrosternal pains (Warts, 2006). The leaves are used to soothe and heal wounds. The fruits are purple/black and are believed to have antioxidants. When the trees mature, the wood can be used for fuel.

*Ardisia elliptica* can be grown with minimal cultivation and management. The plant can bear fruits in just a year from planting. If properly managed, the plant is very productive and fruits are bigger in size. The height is around five meters only which hastens harvesting. Cutting off the main trunk is observed to be better as the plant will sprout and the sprout can again bear fruits the next fruiting season.

Scientific evidence suggests that plants embedded with phytonutrients with antioxidants reduce the risk for chronic diseases including cancer and heart disease. The primary sources of naturally-occurring antioxidants are whole grains, fruits, and vegetables. The main characteristic of an antioxidant is its ability to mop up free radicals which are present in biological systems from a wide variety of sources. Antioxidants as free radicals may oxidize nucleic acids, proteins, lipids, or DNA with great potential to instigate degenerative disease. There are also preliminary reports pointing to the role of oxidative stress in aging. Therefore, foods containing significant levels of antioxidants that can inhibit or delay oxidation of a substrate represent a healthy and logical diet choice.

Phenolic acids, polyphenols, and flavonoids which are considered antioxidants, scavenge free radicals such as peroxide, hydrogen peroxide, or lipid peroxy which inhibit the oxidative mechanisms leading to degenerative diseases (Moniruzzaman et al., 2012).

Several factors can influence the stability of foods and ingredients. These include added and natural antioxidants, temperature, handling conditions, and exposure to light and oxygen. The properties associated with the reduced freshness of processed foods include undesirable changes in flavors, textures, shelf stability, nutritional content, and appearance (<https://www.oxfordbiomed.com/products/food-science/antioxidant-analysis>).

Percentage of alcohol in wine must be ensured to facilitate caution when served. It will also serve as a mean of comparison with the available commercial wines in the market. Knowledge on this character will be a crucial basis for modification of AE products with other fruit wines made in season.

Considering the productiveness of this plant, characterization as to its phytochemical components and antioxidant activity are explored to determine the benefits of the fruits. Since the berries are acceptably bland when in sole consumption. The berries are blended with other tropical fruit extracts for enhancement. Thus, the findings of this report will strengthen the wonder to pursue more AE for nutraceutical and pharmaceutical goals and sustainability.

## OBJECTIVES OF THE STUDY

This study aimed to characterize and develop products from *Ardisia elliptica* berries. Specifically, (1) determine the phytochemical nutrients of AE crude extract, (2) determine the presence of phytochemical nutrients of AE when converted into wine blended with other fruits, (3) compare the antioxidant level of AE wines blended with other fruits, and (4) Compare the alcohol contents of AE wines.

## CONCEPTUAL FRAMEWORK

Innovations and sustainability of any product is a stern pursuit of the government through the Department of Science and Technology and Agriculture and other allied departments. It has played a major role in man's quest for quality of life. It continues to bring changes that are geared towards innovations and discoveries to promote health, well-being and livelihood. Innovations and discoveries brought about by technology, greatly impacted people and the environment. People and Technology can hardly be separated nowadays. People believed that with technology, life became in many ways comfortable through easy communication gadgets, transportation modes, do-it-yourself (DIY) food processing, and appliances, accessible and readily available legit online health and wellness therapeutic hubs, affordable and effective naturally sourced and processed medicines. However, as technology brings ease through developments, its poor applications had resulted in unimaginable unprecedented effects in the exhaustion of resources, damages to the physical nature of resources, and pollution of the environment leading to a serious threat to life and society (Gutierrez, 2021; Kramer, 2012). Though it cannot be underestimated too that technologies paved the way to looking around once more at resources that were overlooked and underutilized before because of the "no use or waste material" mentality.

There are a lot of tropical fruits both native and non-native bearing excessive fruits but not comprehensively in profit due to limited information. One of the agendas of the Development of the Philippines which is adopted by the Department of Science and Technology Region 02 is on Discoveries and Innovations of natural products for food and medicine. One of these wonders but with many potential plants if fully characterized and explored is *Ardisia elliptica*, AE. Four years ago, Quirino State University planted more or less 400 seedlings inside the school. After two years, the plants started to bear fruits. Harvesting of ripe fruits was done from January to February wherein fruits turned purple into black. The fruit has a bland and sour taste and as such it could not be eaten in large volumes as fresh. This fruit is not yet widely known in the province and nearby provinces and the market for the fruit is unavailable. Hence, this study will unleash the potential of the plant with phytochemical analysis and product

development using ardisia fruits as raw materials or main ingredient. Thus, the findings generated will bring new horizons to the proper utilization and conservation of the said species.

With these above dire interests, the researchers conceptualized the process to comprehensively and scientifically be acquainted with AE found in QSU Diffun campus. The study started with the approval of the communication by the Director for Research and Development and presented under the Department of Science and Technology Grant in Aid (DOST GIA) assistance. Before the collection of samples, the researchers consulted the Research Department on the protocols of collection before proper identification and characterization, thus resulting in consultation and canvassing about laboratory protocols from nearby laboratories performing analyses on phytochemical screening, antioxidant activity and alcohol contents. The above-mentioned tests were conducted at Cagayan State University, Central Analytical Laboratory (CSU-CAL) in Tuguegarao City. While for alcohol content of wine by the Department of Science and Technology Region 02 -Regional Standards and Testing Laboratory (DOST 02-RSTL) the steam distillation/ pycnometer method was used. With the protocols followed, the samples were collected and analyzed from March to July 2022. The collection took time because of some concerns as to extraction and period of collection. The sample identification and its laboratory analyses were considered for its characterization. After characterization, the results were analyzed further through literature verification. The results can be utilized for and in consideration, for the development of food products that can be value-adding to *Ardisia elliptica* for produce maximization and further as a raw material for medicinal breakthroughs for health-quality commodities and services.

## **MATERIALS AND METHODS**

### **Research Design**

The present study was based on Descriptive Research. Data used were based on existing findings of the documented laboratory analyses results conducted by an accredited laboratory within the region.

### **Research Environment**

The samples were analyzed in an accredited laboratory which is recognized for performing phytochemical screening, antioxidant, and alcohol content for extracts and wines. 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**

The laboratory instruments used were based on the laboratory protocols.

### **Data Gathering Procedure and Analyses**

The accredited laboratory conducted the characterization of the AE berries through analyses of the samples based on the laboratory protocols. Qualitative analyses of the secondary metabolites were only considered due to the financial limitation of the project and the availability of a laboratory that caters to the needed tests within the region. Below were the

processes used in the study?

For Phytochemical screening (CSU-CAL, 2022), the following methods were used. For the determination of alkaloids, the Mayer's Test. For anthocyanins, the NaOH Test, for flavonoids, the Shinoda Test, Phenols, Ferric Chloride Test, Quinones, the Sulfuric acid test, Saponins, the Froth Test, Steroids, the Libermann-Burchard Reaction, for tannins, the Lead Acetate test and for Terpenoids, the Salkowski Test (Kedariet al., 2011; Wang et al., 1996; (Olszowy-Tomczyk, 2020).)

For the antioxidant activity, the  $\alpha$ ,  $\alpha$ -diphenyl- $\beta$ -picrylhydrazyl (DPPH) Scavenging activity, A free radical scavenging method which is the first approach, simplest method for evaluating the antioxidant potential of a compound, an extract or other biological sources (Kedariet al., 2011; Wang et al., 1996). It used the percent Inhibition (% I) to express antioxidant activity (Olszowy-Tomczyk, 2020).

For % alcohol of *Ardisia elliptica* berry wine with duhat and AE with bignay, 50 mL sample volume was steam distilled to about 50 mL distillate. The distillate was diluted to 50 mL in a volumetric flask. Apparent specific gravity of the distillate was obtained using the pycnometer method. % alcohol by volume was determined using the table \*Percentages by volume 15.56<sup>0</sup> of ethyl alcohol corresponding to apparent specific gravity at various temperatures\* (AOAC 920.57).

## RESULTS AND DISCUSSION

### Phytochemical nutrients of ardisia fruit extract and ardisia wines

**Table 1: Phytochemical nutrients of *Ardisia elliptica* extract, *Ardisia* with bignay and *Ardisia* with duhat wine**

Phytochemical nutrients	Raw materials		
	<i>Ardisia elliptica</i> extract	<i>Ardisia</i> with bignay wine	<i>Ardisia</i> with duhat wine
Anthocyanins	+	+	+
Flavonoids	+	+	+
Phenols	-	+	+
Quinones	+	+	+
Saponins	-	+	+
Tannins	+	+	+
Terpenoids	-	+	+

Legend:

+ - presence

- Absence

Table 1 shows the phytochemicals present in the AE extract and when the AE extract was converted into wines with other fruits. AE extract was blended with other fruits in order to satisfy the characteristics of fruits needed for wine making such as aroma and acidity that

ardisia fruit is deficient. Phytochemicals are a powerful group of compounds with a very important role in plant development, including relevant physiological processes in reproduction, symbiotic association, and interactions with other organisms and the environment (Forniet al., 2019).

The phytochemical screening of *Ardisia elliptica* extracts in liquid form showed the presence of anthocyanins, flavonoids, quinones, and tannins. These were also present when the AE extract was converted into wine mixed with bignay and duhat fruits.

Bignay and duhat wines are the available tropical wines already processed and made commercially by the Quirino Young Entrepreneurs Association for more than 8 years (QYEA; a student organization established to extend aid in skills and entrepreneurial development of students based in QSU Diffun campus). Since the wines included had made their names in the processed and in the market, blending the AE extracts with the wines will make a simple innovation as to sensory characteristics at the same time utilizing the berries, helping the farmers and household owners with excess duhat and bignay during the fruiting season.

Duhat *Syzygium cumini* is commonly known and has been studied to have the following contribution to maintaining health and wellness. Consuming raw and processed duhat fruit improves immunity because of the richness in vitamins B complex and C, iron, potassium, calcium, and minerals; it has antibacterial, antifungal, and antiviral properties to protect from many different diseases; it adds to the production of hemoglobin as it has a high source of iron; aids in liver health particularly with the expulsion of toxins in the body; as a rich source of antioxidants because it contains anthocyanin and Vitamin C that helps protect from free radical damages; treats different digestive disorders such as diarrhea and ulcer; it has antibacterial properties that can help deal with infections in the digestive system to prevent disorders; relieves pain and inflammation. Boiling the bark of the duhat tree and using the warm water as an application topically to parts of the body that are in pain and inflamed; improves stamina and regulation of blood pressure.

Since the seed extracts contain ellagic acid which is a certain type of antioxidant that can keep in check the rapid fluctuations of blood pressure. Its antioxidant properties help fight free radicals that cause premature aging of the skin; it aids with diabetes management since duhat has a low glycemic index which makes it healthy food for diabetics.

This fruit also contains oleanolic acid which is known to have anti-diabetic properties. Oleanolic acid can improve insulin response and secretion of chemicals that are responsible for lowering blood sugar; helps to protect against cardiovascular diseases since it contains triterpenoids which help keep the heart healthy. These can inhibit cholesterol in the body; treat cough and sore throat because of their vitamin C content, which can help with the healing process and prevent infections. It can also act as an antihistamine that can treat allergic reactions that may cause coughs and colds; is a home remedy for hemorrhoids, drinking duhat juice can help treat bleeding hemorrhoids.

It is also being observed to aid in treating veins that are prone to bursting; treats bruises and cuts because it can speed up the process of healing and prevent infections because of its



antibacterial properties (Baliga et al., 2011; Mercado et al., 2021; Manaoiset al., 2020; Zhang et al., 2015).

Similarly, bignay *Antidesma buniu* fruit juice contained phenols, anthocyanin, ascorbic acid, and flavonoids. The scavenging activities obtained from DPPH and ABTS methods were 0.110 mg/mL and 0.126 mg/mL respectively. It was determined that the fully ripe flesh and seeds of bignay fruit have the highest antioxidant content and activity regardless of the heat treatment applied. It has also an antimutagenic activity (Barcelo et al., 2016). The above results indicate that bignay fruits contain health-promoting chemical compounds and can be used as a natural source of antioxidants (Israel et al., 2020).

Bignay fruits can be as small and underutilized as it seems but have enormous benefits. Here are some. Bignay can promote hair growth since it contains flavonoids, tannin, and procyanidin. It aids with detoxification; is a good source of antioxidants. Bignay fruits contain catechins that have antioxidant properties. With nutrients such as calcium, iron, niacin, phosphorus, protein, riboflavin, and thiamine; it aids with liver health since it can reduce the levels of alanine aminotransferase and aspartate aminotransferase which keep the liver healthy;

Drinking bignay tea may be a good natural home remedy if there is a urinary tract infection; it improves skin health. Bignay is even used in countries like Malaysia as an ingredient in making face packs; helps manage blood pressure; helps boost the Immune System. Since bignay contains antioxidants and antimicrobial properties, it can regulate blood pressure, as well as the antioxidants within, for making the body's heart problems. When consumed more than necessary, it can give a laxative effect. It may help with diabetes management. It is said that the consumption of bignay may be able to help people who are suffering from diabetes by regulating their blood sugar concentration.

These two indigenous fruits complemented the phytonutrients present in the AE extracts. It can be gleaned that the AE maintained its phytochemicals (anthocyanins, flavonoids, quinones, and tannins) even when mixed with other fruits.

Phenols, saponins, and terpenoids were detected in the wines with AE extracts but were not present in the crude extract per se.

Anthocyanins are a water-soluble flavonoid widely present in fruits and vegetables. Dietary sources of anthocyanins are fruits and vegetables containing high levels of natural colorants. Cyanidin, delphinidin, malvidin, peonidin, petunidin, and pelargonidin are the six common anthocyanidins. The health benefits of anthocyanins have been widely described in the prevention of diseases associated with oxidative stress, such as cardiovascular and neurodegenerative diseases (Mattioli et al., 2020).

Parts of plants and cereals (either fresh or as juice) or purified anthocyanin-rich extracts have shown significant improvements in low-density lipoproteins oxidation, lipid peroxidation, total plasma antioxidant capacity, and dyslipidemia as well as reduced levels of Cardiovascular Disease/s (CVD) molecular biomarkers (Reis et al., 2016). Nowadays, with the growing

interest of consumers and the food industry of the multiple biological properties and technological applications of anthocyanins, the conventional extraction techniques based on thermal technologies can compromise both its the recovery and stability which when not properly addressed can reduce its global yield and, or limit its application in food systems, thus appropriate knowledge, materials, and technology must be utmost considered (Arruda et al., 2021).

Accordingly, among all extracts of AE, the highest phenolic and flavonoid content is found in the root extract which resulted in the most potent free radical scavenging activity revealed by the DPPH and Ferric Reducing Antioxidant Power assay (FRAP) assay. The roots and flowers showed the highest bergenin ( $3.36 \pm 0.22$  mg/g dry weight) and quercetin ( $2.99 \pm 0.10$  mg/g dry weight) content, respectively (Buraphaka et al., 2022; Fang, 2015).

Likewise, through a 70% ethanolic extraction method from AE leaves, a total of 46 metabolites were tentatively identified, including flavonoids, benzoquinones, triterpenes, and phenolic derivatives. This is a promising functional ingredient for food production and for the development of phytomedicinal products (Wong et al., 2021, Dey, 2013; Newell, 2010).

Phenols were present in bignay and duhat wine. Formation of brown melanin from the oxidation of phenolic compounds, Polyphenol oxidase (PPO) are indicators of its presence (Jiang et al., 2016). It must be noted that when fruits and vegetables are bruised, cut, peeled, diseased, or exposed to any abnormal conditions, they darken rapidly on exposure to air as a result. These reactions may alter both the physicochemical and the immunological properties of food proteins. With these, quinones trap odoriferous compounds and contribute to the formation of aroma compounds through (Strecker) degradation of amino acids. Oxidative dimerization of chlorogenic acids in the presence of amino acids leads to the formation of green benzacridines, which are a promising alternative to chlorophyll as food colorants (Scheiber, 2018; Stites et al., 2000).

Although enzymatic browning is a natural phenomenon that occurs widely in many fruits and vegetables, some fruits degrade and bring loss to the producer of the crop. Nowadays, the emphasis is now on consumer-oriented innovations in the food industry. Consumers tend to urge the use of natural and environment-friendly PPO inhibitors (Moon et al., 2020).

On the other hand, tannins can react with and precipitate proteins forming stable water-insoluble copolymers. It was first applied to plant constituents capable of transforming raw animal skin into leather because of cross-linking with proteins. In plants, tannins can be detected by the gelatin test. Whereby the tannins precipitate the gelatin protein. This was observed during the processing of ardisia products whereby it coagulated with the substances found in other wines. But with the presence of fruits with acidic contents, the condensed tannins are decomposed into red insoluble compounds known as phlobaphene (the red tannins) (Guevarra et al., 2005).

While saponins and terpenoids were not present in the crude AE extracts, their presence in the bignay and duhat greatly influence the effect of the AE product's phytochemical and sensory. Saponins are plant steroids that can foam when mixed with water and boast various health



benefits. They exhibit anti-inflammatory and immune-boosting properties as well as antibacterial effects (Picincu, 2018; Ashour et al., 2019; Price et al., 2009).

Likewise, bioactive compounds such as terpenoids which are found in plants with essential oils possess a wide range of biological activities including anticancer, antimicrobial, anti-inflammatory, antioxidant, antiallergic, antimicrobial, and food preservative properties that are considered real potential applications in the food industry (Maysitaet al., 2022; Josheet al., 2019; Grassman, 2005).

Since 1994, 50% of drugs introduced were from natural products or naturally- product derived compounds. Based on research trends, natural products will continue to emerge to be vital sources of lead compounds for new drugs. One of these sources for the treatment of cardiovascular diseases such as antiplatelet and anticoagulant drugs is *Ardisia elliptica*( Ching, 2011). These findings showed that *Ardisia elliptica* is a potential source of raw materials for food and new medicines.

### **Antioxidant Analyses of AE with Bignay wine and AE with duhat wine**

Antioxidant play an important role in food preservation by inhibiting oxidation processes and contributing to health promotion rendered by many dietary supplements, nutraceutical and functional food ingredients. For proper selection of method(s) and for valid evaluation of antioxidant potential in desired applications, there must be a thorough comprehension of the principle, mechanisms, advantages and limitations of the measurement assays (shadidi and zhong, 2015). Plants have an innate ability to biosynthesize a wide range of non-enzymatic antioxidants capable of attenuating reactive oxygen species (ros) - induced oxidative damage (kasoteet al., 2015). The possible reason for the presence of these antioxidants in plants is that plants lack an immune system unlike animals. According to devis (2008) berries deliver super-healthy antioxidants that help fight disease which can be acquired from *ardisia* fruit extract that were converted into wines either with bignay or duhat fruits.

**Table 2: Antioxidant level of *Ardisia* with bignay wine and *Ardisia* with duhat wine**

Sample Description	Result (%) Antioxidant Activity
<i>Ardisia</i> with Bignay Wine	88.87%
<i>Ardisia</i> with Duhat Wine	89.80%

Table 2 indicates the antioxidant activity of ae extract with duhat and bignay wines. *Ardisia* with duhat wine had a higher oxidant activity (89.80%) than *ardisia* with bignay (88.87%). This shows that the higher the percent of inhibition, the higher is the antioxidant activity (olszowy-tomeczyk, 2020). Antioxidant activity represents the ability to inhibit (reduce) all molecules having high oxygen/red potential, which makes them destructive for body structures (tirzitiset al., 2010).in addition, a percent inhibition depends upon the concentration of the antioxidant, concentration of the oxidant (radicals), the used solvent, the used reagents ratios, incubation time, temperature as well as the presence of metal, hydrogen, and water in the measuring systems (dawidowiczet al., 2011). One possible reason why many studies on antioxidant

supplements do not show a health benefit is because antioxidants tend to work best in combination with other phytonutrients or substances. The presence of phytonutrients of the ae extract and in the wines being blended with other fruits, proved that ae berries are full of nutrients and disease fighting antioxidants, a potential rich source of raw materials.

### Alcohol Content Analyses of AE with Bignay wine and AE with duhat wine

**Table 3: Percent alcohol content of AE with bignay wine and AE with duhat wine**

Sample Description	Result (g/100g)	Method used
Ardisia with Bignay Wine	11.28	Steam distillation/Pycnometer
Ardisia with Duhat Wine	11.72	Steam distillation/Pycnometer

Table 3 revealed that the alcohol content of AE berry wine was 11.29% while AE wine with bignay was 11.72 %.

Ardisia elliptica berry wines are made by mashing the berries and fermenting the juice. Capitalization (adding sugar) is done to develop high enough levels of sugar to reach the standard alcohol percentage of 12 to 14 percent. Most other fruits have less sugar than commercial fruit wines like grapes and need to have some sugar added to their fermentation to reach appropriate levels of alcohol content (Bender, 2018).

Most fruit wines should contain anywhere from 3 to 6 pounds of fruit per gallon of wine, for AE it was about 5kg. And to produce a lighter more delicate wine, a smaller amount of fruit is needed. For a heavier, more intense wine, a larger amount of fruit.

Wine's standard of identity is very important. By law all wine must contain not less than 7% and not more than 24% of alcohol by volume. According to classes of wine, AE berry wine was considered class 5 wine, also called a fruit table wine or light fruit wine, or light berry wine because the alcoholic content does not exceed 14% by volume.

The major reason for using alcohol (especially wine) in food is its perceived flavor or taste, as an ingredient of another food and used as processing aids.

FDA supervises all other food items. (If a food contains more than 7 percent alcohol by volume, that food comes under the jurisdiction of the Bureau of Alcohol, Tobacco, and Firearms (ATF)(Riaz).

Ethanol in wine acts as an essential cosolvent (along with water) in extracting fruits constituents, it serves as a reactant in the generation of important volatile compounds (e.g. ethyl esters) and is crucial to the sensory properties, stability and ageing of wine(Velicet al., 2018).

There were no published studies yet regarding this specific type of food applications of AE as far as the researchers are concerned.

## CONCLUSION

In light of the findings, the following conclusions were drawn:

1. *Ardisia elliptica* berry extracts positively exhibited the presence of the secondary metabolites: anthocyanins, flavonoids, tannins, and quinones. They are all present when converted into wine with bignay and duhat fruits. These are potentials for medicinal breakthroughs for healthcare services enhancements and food developments for value-adding products.
2. *Ardisia elliptica* berries extracts combined with bignay and duhat wines had a high level of antioxidant activity. This activity in fruits particularly AE helps vigorously in food preservation and as a disease combating agent.
3. *Ardisia* wine had 11.29% alcohol content while *ardisia* with bignay wine showed 11.72% alcohol content. This showed a low level % alcohol by volume.

## RECOMMENDATIONS

Based on the findings and conclusions, the following recommendations are offered.

1. Based on the fundamental and scientific information about *Ardisia elliptica*, as a potential food source and for medicines, researchers should include documenting the morphology and practices on the AE parts utilization.
2. Based on the analyses, researchers must pursue the development of food products and verification studies on specific diseases or ailments to strengthen the findings of the study particularly having a nutritive value and a potential medicine.
3. Further analysis should be conducted using other solutions and advanced test protocols and equipment to verify results.
4. Related studies on other parts of the plant should be conducted.

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## CONFLICT OF INTEREST

The authors do not have any conflict of interest to declare.

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