



# Development of Kamias (*Averrhoa bilimbi* L.) Jam with Coconut Water

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**Abstract:** Processing of fruits to become a staple commodity is one way of addressing the cost and challenge of getting good nutrition at a lower price, especially if it maximizes the use of readily available and underutilized fruit as a source of food and nutrition. The high nutritional value of fruits that can help promote good health and well-being offers many opportunities for consumers. This paper aimed to describe the development of Kamias (*Averrhoa bilimbi* L.) in coconut water jam as a practical gourmet alternative that can be economically competitive in the market and can be made affordable to many. Its unique underrated nutritional value makes it even more, a revelation among the big names in the gourmet world. In order to maximize the nutritional benefits of this fruit at the same time to make known its potential operational utility, this paper describes the development of the kamias jam, its nutritional value, and its health benefits as stated in various studies that validate its nutritional and medicinal advantages and beneficial side effects. The use of coconut water enhances the sensory attributes in terms of the flavor and texture of the kamias jam. The development of value-added products from the kamias jam can generate good nutrition in the community and livelihood in the locality.

**Keywords:** Kamias Jam, Coconut Water, Nutritional Value, Health Benefits

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## 1. Introduction

The importance of good health in one's life becomes a focal point as the COVID-19 pandemic brought a standstill in almost all facets of life. It has restricted our movements, especially the routine that we have long established as human beings. However, it has also allowed us to maximize what we have within our parameters vis a vis the call to value good health. Good nutrition results in a healthy mind and body and has become a constant concern for all, especially in this time of the pandemic. However, the challenge of having good nutrition paved the way to produce alternative food products using available materials like fruits to get the nutritional value from available products that are made into jams. One of the most common but underutilized fruit in the Philippines is the kamias, which has a number of health benefits and can even be used as a medicinal that may treat certain diseases. As they abound in different areas in the country, maximizing their nutritional properties and enriching their taste led to the development of the kamias in coconut water jam.

The preferred scientific name of kamias is *Averrhoa*

*bilimbi*. It has many names in the Philippines' different parts, such as iba, ibag, ibe, kalmias, kalanuas, kalinguia, kolonanas, kolonauasm killing-iba, pias, and puis. This unappreciated fruit is the kamias or bilimbi, whose fruits are sometimes taken for granted. They are common in the countryside as one of nature's most abundant fruit in the region. The sour fruit is a natural source of vitamins B and C, iron, phosphorus, and antioxidants. Its other excellent benefits: Its leaves relieve coughing, thrush, hemorrhoids, stings, itches, pimples, and skin eruptions. Its fruits can control gastrointestinal bleeding in the stomach, fight cholesterol, fever, and inflammation, and prevent cough, beriberi, and scurvy. It's antidiabetic and antibacterial. The juice from its fruit offers some household purposes, like cleaning and bleaching. It removes rust and stains. Some people also eat it with salt, soy sauce, or sugar. Just as some people relish green mango juice, some enjoy sweetened kamias juice as reflected in Valencia & Bismark (2015) [20]. Its other excellent benefits include relieving coughing, thrush, hemorrhoids, stings, itches, pimples, and skin eruptions. The fruits can control gastrointestinal bleeding in the stomach,

fight cholesterol, fever, and inflammation, and prevent cough, beriberi, and scurvy. It's antidiabetic and antibacterial. *Averrhoa bilimbi* is a fruit with many benefits, but its usage is not optimal. A potential bilimbi role against various ailments has been thoroughly evaluated, interpreted, and discussed. Several pharmacological studies have demonstrated this plant's ability to act as an antidiabetic, antihypertensive, thrombolytic, antimicrobial, antioxidant, hepatoprotective, and hypolipidemic agent. A bilimbi holds excellent value in complementary and alternative medicine, as evidenced by the substantial amount of research. As a bilimbi so far, the biologically active agents have not been isolated from this plant. This can be an excellent scientific study for the future antidiabetic, antihypertensive, and antimicrobial effects as stated in the article of Valencia and Bismark (2015). [20]

*Averrhoa bilimbi*, or its local name kamias, is found in the Philippines and Southeast Asia forests. The plant's fruit is commonly used as an ingredient for cooking but can treat wounds, rheumatism, venereal diseases, poisonous bites, and beriberi. The leaves can be used for cough and relieve rectal inflammation, while the flowers can be useful for coughs and thrush (Roy, Geetha, & Lakshmi 2011). [16]

With the identified health benefits provided by the chemical components of the kamias (*Averrhoa bilimbi* L.), this paper presents the development of the kamias jam as a cost-effective and healthy option for wellness. Thus, this paper aims to describe the preparation and development of the kamias (*Averrhoa bilimbi* L.) in coconut water jam. It also presents the health benefits of the kamias jam as a more economical option for a gourmet alternative that can provide nutritional value at a low cost that can benefit the young and old when consumed in moderation. The kamias jam offers a good source of Vitamin C, Vitamin B2, Vitamin B3, Vitamin B1, iron, protein, carbohydrates, and other minerals.

## 2. Literature Review

Studies conducted on the acceptability of kamias, bilimbi fruit, as a food or beverage substitute like wine (Caoli & Magsino, 2017) [5] and as candy (Gaytos, Abalorio, Lavilla & Abalorio, 2019) [7] are available in different research publications. Likewise, another study that used it as juice (Astillo, 2020) [3] has shown beyond doubt its practicality, economic advantage, and health benefits. *Averrhoa bilimbi* Linn. is principally cultivated for medicinal purposes in many tropical and subtropical countries. A literature survey about this plant shows that *A. bilimbi* mainly focuses on folk medicine in the treatment of diabetes mellitus, hypertension and as an antimicrobial agent as stated in Alhassan & Ahmed (2016) [1]. Their paper presents an up-to-date and comprehensive review of the ethnomedicinal uses, different chemical constituents, and pharmacological activities of *A. bilimbi*. They espoused that these biologically active agents have not been isolated from this plant, and this can be an excellent scientific study for the future antidiabetic, antihypertensive, and antimicrobial implications. Hence, this

review targets the diverse traditional claims and pharmacological activities of *A. bilimbi* concerning carrying out more scientific studies to isolate active principles through advanced technology.

However, there is scarce literature and studies that had ventured into creating a gourmet alternative using the kamias as a jam that can be consumed by both young and old alike. In this time of the pandemic, when the cost of commodities has soared high, there is a need to look into creating an affordable sandwich spread that has several nutritional benefits. In tropical third world countries where bread is one of the staple food, the jam becomes a perfect pair to the bread to reinforce the meal.

The use of local fruit as traditional medicine is widespread in Asia. The World Health Organization (WHO) that about 80% of people living in Africa and Asia use traditional medicine to address health-care needs. This continuing demand for conventional and complementary medicine worldwide, especially in developing countries, has given rise to new ways of developing new recipes maximizing the fruits' health benefits by creating new foodstuffs. There are numerous uses of the kamias fruit as developed into new food products. In Pakistan, for example, the fruit is often preserved in sugar and sometimes pickled (Flora of Pakistan, 2015). In Malaya, the fruits are processed and made into dried sliced snacks (Hanelt et al., 2001) [8]. Many use the fruits to add a tart or acid flavor, much like using lemon juice and tamarinds (Staples and Herbst, 2005) [18]. Although the fruit is generally too acidic when eaten raw, Morton (1987) reports that the green, raw fruits make a relish, served with rice and beans in Costa Rica and that ripe fruits added to curries are familiar. In Costa Rica, the species is used both as a flavoring and a preservative (Burger, 1991). *A. bilimbi* is made into chutneys in place of raw mango and tamarind. Flowers are also collected, washed, air-dried, and preserved in sugar syrup (Ravindran, 2016) [15]. In Pakistan, the fruit is used as an astringent and is eaten to cure piles and scurvy (Flora of Pakistan, 2015). In the Philippines, its leaf paste is applied as a poultice on itches, swellings, mumps, and rheumatism and in other types of skin eruption. In other Asian traditions, the juice from the fruit is used in a concoction for fevers, a paste can be made from the leaves and applied topically to cure mumps, rheumatism, and pimples, or brewed to treat syphilis, and an infusion of the flowers is used to treat coughs and thrush (Quisumbing, 1951).

In the Philippines, the leaves of Kamias are applied as a paste or poulticed on itches, swellings of mumps and rheumatism, and skin eruptions. Elsewhere, they are applied to poisonous creatures as espoused in Orwa et al., (2009) [12]. Likewise, in Philippine cuisine, the fruits are widely used to add a tart or acid flavor, much like lemon juice and tamarinds (Staples and Herbst, 2005) [18]. However, the fruit is generally regarded as too acid for eating raw, as Morton (1987) reports that the green, raw fruits make a relish with rice and beans in Costa Rica, and that ripe fruits added to

curries in the Far East are familiar. In Costa Rica, the species is used both as a flavoring and a preservative. *A. bilimbi* is made into chutneys in place of raw mango and tamarind. Flowers are also collected, washed, air-dried, and preserved in sugar syrup (Ravindran, 2016) [15]. A syrup made from kamias fruit is used to treat inflammatory conditions (Yap, Jr., 2018). [23]

The chemical properties of kamias (*bilimbi*) have been found to have health benefits, as claimed by studies. It was evident that the ethanolic crude extract of *A. bilimbi* and *Z. mauritiana* growing in Bangladesh showed significant antimicrobial and cytotoxic activities. The strong cytotoxic properties of the extracts suggested bioactive principles in the plants (Karon, Mahmood, Uhg, Chowdhury, Hossain, Rashid (2011). [9]

Phytochemical research in *Averrhoa bilimbi* verifies that the plant contains; alkaloids, tannin, saponins, flavonoids, cardiac glycosides, triterpenes, phenols, triterpenoid, citric acid, oxalic acid, and D-3- hexanal but the absence of phytosterols in different extractives. The presence of saponin, triterpenoid, alkaloid, oxalic acid, and D-3-hexanal contributes to its anti-fungal agent, antimicrobial agent, anti-lipidemic agent, and antioxidant (Polterait, 1997). [13]

*Averrhoa bilimbi* contains high levels of oxalate as records show that acute renal failure due to tubular necrosis caused by oxalate has in several people who drank the concentrated juice on successive days as treatment for hypercholesterolemia. These people were prompted into consuming this concoction by local media. This is in played up studies done in experimental animals (Pushparah & Natesan, 2004) taken from *In vitro screening of Anti-Fungal Effect of Averrhoa bilimbi Leaves Methanolic Extract against Microsporum canis* Vince Carlo A. Carandang, Mark Renill V. Hernandez and Clint Erick Alvaira Lyceum of the Philippines University (LPU). [14]

Kamias has a property to chelate metal cations. Based on a study by Daud, Hashim, and Samsulrizal (2013) [6], the extract was effective in reducing the thrombophilic condition in rats. They extracted the fruit using ethanol and concentrated it using a rotary evaporator. Results show a decrease in clot formation from the rats treated with the fruit extract.

Kamias' ability to chelate metal cations is due to the presence of oxalic acid. Oxalic acid is an odorless, colorless, and healthy organic acid naturally present in plants and vegetables. (Sales, Andaya, Maylas, 2018) taken from *Advent University of the Philippines, Journal of Health Sciences April 2018 | Vol. 1, Issue 1* [17]. Likewise, the study of Muhamad, Yusoff, and Gimnun (2015) [11] espoused that *Averrhoa bilimbi* fruits contain appreciable amounts of polyphenolic compounds such as nicotinic acid, pantothenic acid, and catechin, used as food supplements. Another study assessed the antioxidant potential of fresh fruit juice of *Averrhoa bilimbi* in the paracetamol intoxicated Wistar albino rats. The study showed that *A. bilimbi* extract had increased the antioxidant activity significantly both in blood and tissues of animals, and the efficacy of the extract was

dose-dependent. The phytochemical studies showed the presence of flavonoids, phenols, and glycosides in the extract. The antioxidant property of *A. bilimbi* may be the contribution of these phytoconstituents (Thamizhselvam, Liji, Sanjayakumar, Sanal, Vasantha, and Swamy (2015) [19]. In another study by (Kurup & Mini, 2016) [10], they stated and discovered a need for safer and effective medicines from natural sources having a potent antidiabetic activity like *Averrhoa bilimbi* Linn.

### 3. Methodology

This study made use of the descriptive research design that utilized observation and record-keeping techniques as it described the preparation of the kamias jam in fresh coconut water combined with other ingredients like salt, sugar, and milk.

#### Materials, Tools, and Equipment

The materials, tools, and equipment used in making the kamias in coconut water jam are the prepared pre-cut kamias fruits, knife, chopping board, mixing bowl, measuring cups and spoons, wire whisk, fork, stainless casserole, ladle, sterilized bottle, gas stove and pressure cooker for sterilization and to promote the shelf of the jam. The raw materials used were coconut water, sugar, milk, and salt. The combined ingredients provided the nutritional value of Vitamin C, Vitamin B2, Vitamin B3, Vitamin B1, iron, protein, carbohydrates, and other minerals.

### 4. Preparation of the Kamias Jam

The kamias were washed properly, and the sides were cut. After appropriately cut, it is soaked overnight in fresh coconut water. Then the water is removed and drained. The seeds were taken out and washed again with coconut water, then boiled still with coconut water in preparation for jam. The seeds were taken out and were and mashed. It was then weighed in to achieve the right consistency to give way to the other ingredients. The other ingredients include brown sugar or muscovado, coconut water, water, milk, and salt mixed with specific measurements. It was then combined with coconut water, sugar, milk, and salt. Add the kamias fruit and letting to boil again to become a jam. Remove the jam from the heat. Sterilize the bottle jam. Pack the jam and place it into the sterilized bottle. Cool the bottled kamias jam and put the label after it is covered.

Table 1. Formulation of the Kamias Jam.

Ingredients	Composition (%)
Sugar	49.8%
Kamias	24.9%
Coconut water	18.7%
Milk	6.2%
Salt	0.49%

It can be noted that the composition of the production of the coconut water enriched Kamias (*Averrhoa Bilimbi* L.) jam is comprised of kamias fruit 24.9%, sugar 49.8 %, coconut

water 18.7%, milk 6.2 %, and salt 0.49%. This formulation of the kamias jam represents the healthy ingredients based on the composition of the kamias jam that can provide nutritional benefits to its consumers. Likewise, it can also be a potential commercial product that can be produced to address some nutritional deficiency issues. The availability of the fruit and the affordability of the kamias jam can motivate people to use this product as a staple commodity that can provide nutritional benefits to its consumers.

#### 4.1. The Physical and Chemical Tests Results of Coconut Water Enriched Kamias (*Averrhoa Bilimbi* L.) Jam

Table 2. Parameters of the kamias jam with coconut water.

Parameters	Amount/100g	% daily value
Moisture	94.2-94.7 g	
Protein	0,61 g	1,22 %
Ash	0.31-0.40 g	
Fiber	0.6 g	2,4 %
Phosphorus	11.1 mg	1,11 %
Calcium	3.4 mg	3,4 %
Iron	1.01 mg	5,61 %
Thiamine (Vit B1)	0.010 mg	0,66 %
Riboflavin (Vit B2)	0.026 mg	1,529 %
Carotene (Vit A)	0.035 mg	1,16 %
Ascorbic Acid (Vit C)	15.5 mg	25,83 %
Niacin (Vit B3)	0.302 mg	1,51 %

The kamias jam parameters in coconut water reflect the daily value percentage based on a 2000 calories diet. It is just within the health standards vis a vis jam.

Table 3. Treatment formulation with varying concentrations of coconut water.

Jam treatments	Sugar (g)	Camias (g)	Drinking water (g)	Coconut water (g)	Lime (g)
T <sub>0</sub>	3000	1500	1500	-	30
T <sub>1</sub>	3000	1500	750	375	30
T <sub>2</sub>	3000	1500	375	750	30
T <sub>3</sub>	3000	1500	-	1500	30

#### 4.3. Sensory Evaluation

The formulated kamias jam with varying concentration of coconut water was subjected to sensory evaluation using 5 – point scale descriptive test and 9 – point hedonic scale was forty-nine (49) expressed that they extremely like extremely and

Based on the results of the physical and chemical test of coconut water enriched kamias (*Averrhoa Bilimbi* L.) jam, it shows the nutritional value and composition of the kamias jam, which is the Daily Value based on the 2000 calories diet. It implies that the kamias in coconut water jam can provide the needed vitamins and minerals that can be consumed and even provide medicinal effects. This result affirms the other study that shows that *A. bilimbi*, as a folk medicine, is used to treat diabetes mellitus, hypertension and as an antimicrobial agent (Alhassan & Ahmed, 2016) [1]. A syrup made from kamias fruit is used to treat inflammatory conditions in the Philippines (Yap, Jr., 2018) [23]. The chemical properties of kamias (bilimbi) have been found to have health benefits, as claimed by studies. It was evident that the ethanolic crude extract of *A. bilimbi* and *Z. mauritiana* growing in Bangladesh showed significant antimicrobial and cytotoxic activities. The strong cytotoxic properties of the extracts suggested the presence of bioactive principles in the plants (Karon, Mahmood, Uhg, Chowdhury, Hossain, Rashid (2011). [9]

#### 4.2. Kamias Jam Preparation

This study used the fresh kamias fruit from Liloan, Cebu, the Philippines, as they have abundant harvest within their locality. The preparation of ingredients, utensils, and equipment used in the study was gathered and well - organized. Ingredients on the preparation of jam were weighed using a digital weighing scale. Each treatment was added with varying concentrations of coconut water, as shown in Table 1.

only one (1) disliked. Descriptive and preference testing was done by ten (10) expert panelists and 50 consumer panelists. Among the fifty consumer panelists, twenty were professional teachers, fifteen were non-teaching staff, and there were also fifteen students who took part in assessing the acceptability of the kamias jam based on their sensory evaluation.

Table 4. Point Scale Descriptive Test.

5 – point Scale Descriptive Test				
Color	Flavor	Odor	Texture	
5 Choco Brown	Sweet	Sweet Fruity	Extremely Sticky	
4 Dark Brown	Sweet and Sour	Sour Fruity	Very Sticky	
3 Brown	Sour	Fruity	Moderately Sticky	
2 Golden Brown	Bitter Sweet	Floral	Slightly Sticky	
1 Light Brown	Salty sweet	Subtle	Watery	

The results of the sensory observation of the formulated kamias jam reflect its acceptability and usability. It described the development of the process of kamias fruit made into a jam was defined based on color, flavor, odor, and texture. The outcome was favorable, which prove the acceptability and usability of the kamias jam. The present study's result

affirms the study of Anuar and Salleh (2019) [2], which claimed that bilimbi fruit could be used to make a fruit jam with good sensory acceptability, which suggests high market potential due to TPC that can contribute to antioxidant activity. Processing this fruit into jam allows it to be eaten by people of all ages. Making bilimbi jam is a transferable skill

and is a relatively straightforward procedure. Bilimbi jam can be made at home, especially by those who already have bilimbi trees in their backyard.

## 5. Conclusion and Recommendation

The processed kamias fruit made into a kamias jam combined with essential ingredients provided the nutritional value of Vitamin C, Vitamin B2, Vitamin B3, Vitamin B1, iron, protein, carbohydrates, and other minerals. The high nutritional value of this kamias fruit and its consumption through this wonder kamias jam can serve as an affordable vitamin substitute that can promote good health and well-being to its consumers. Its unique, underrated nutritional value makes it even more, a revelation among the big names in the gourmet world. This study proves its nutritional attributes at the same time to make known its potential operational utility. On the other hand, the chemical components with their nutritional value contribute to its bio-activity are essential to the plant industry, biotechnology, and biomedical fields. The use of coconut water enhances the sensory attributes in terms of flavor and texture on the kamias jam with an acceptable concentration of 50%. The development of value-added products from kamias fruits made into kamias jam can generate good nutrition in the community and livelihood in different localities in the Philippines, which can also be replicated in other countries.

With the need to improve health and well-being, especially during the pandemic, future studies on this topic are highly recommended to provide varied contexts on its health effects and its nutritional impact on consumers and health enthusiasts. Similarly, an economic impact analysis study is also recommended.

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