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# THE INDIGENOUS KNOWLEDGE OF THE MEDICINAL COMPONENTS OF *MORINDA CITRIFOLIA* L. (NONI) COMPARED TO SCIENTIFIC KNOWLEDGE AS AN INCOME GENERATION STRATEGY TO LIVELIHOOD

Ayeh S., Arthur E. M., Teye E. K. and Adinkrak B.

Department of Agribusiness, School of Business and Economics,
Presbyterian University College, Ghana. P.O. Box 59, Abetifi Kwahu

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## ABSTRACT

Noni scientifically known as *Morinda citrifolia* L. of the rubiaceae family is widely known in Southeast Asia and Australasia with a wide range of uses. Among the Polynesians, fermented juice is very popular as traditional medicine with a variety of therapeutic properties. The traditional medicinal properties of noni have in recent times permeated the Ghanaian society with the usage increasing with minimal scientific information. The scientific information gap in Ghana is the thrust of this study. The ripe fruits, collected from one plant, were fermented traditionally and the juice was subjected to laboratory analyses for chemical analysis and phytochemical screening. The laboratories at the Food Research Institute and Ghana Standards Authority were used respectively since either of the laboratories could not perform both the chemical analysis and phytochemical screening.

Field survey, using simple random sampling, was employed to sample thirty (30) respondents at Akim Oda to assess the knowledge of noni as an emerging plant of potential in its cropping and value addition.

The results of the laboratory investigations were the composition of minerals (iron, zinc, sulphur, but no copper) and vitamin C; and the presence of phytochemicals namely tannins, flavonoids, saponins and alkaloids. These confirm the therapeutic properties of the fermented juice thereby favouring the indigenous knowledge as traditional medicine.

**Keywords:** Total Polyphenols Content (TPC), Antioxidant Capacity Noni, Phytochemical, Therapeutic, Nutraceutical

  

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## INTRODUCTION

Herbal and natural products of folk medicine have been used for centuries in every culture throughout the world. Due to the prohibition of sub-therapeutic use of antibiotics in the food and animal industry by some countries, the possibility of a ban in other countries, and increasing demand for natural products with health benefits, the importance of medicinal plants have increased in recent years. Noni *(Morinda citrifolia),* also known as Indian Mulberry, Ba Ji Tian, Cheese Fruit and various other names in different countries, is a popular medicinal plant. Its fruit is rich in a variety of phytochemicals and polysaccharides. The results from the limited studies demonstrated the immunomodulatory effect of these constituents in the in vitro experiments (Hirazumi *et al*., 1996, 1999, Furusawa *et al*., 2003, Pawlus *et al*., 2005, Akihisa et al., 2007). Considering the health benefits of noni juice, the European Commission of Health and Consumer Protection accepted it as a novel food (Opinion of the Scientific Committee on Food on Tahitian Juice, 2002). Popular medicine has been using natural and herbal products for centuries in all cultures of the world. The scientific community and health professionals have shown an increasing interest in research investigating the therapeutic benefits related to these products. Among the widely used medicinal plants, is *Morinda citrifolia* L. (noni), which was discovered 2000 years ago by ancient Polynesians (Wang *et al.*, 2002; Zin, Hamid, Osman, 2002).

Phenolic compounds such as flavonoids are the most active and common antioxidants present in fruit and vegetables (Nijveldt *et al*., 2001). These compounds have an antioxidant function which results from a combination of chelating properties and scavenging of free radicals as well as inhibition of oxidases and other enzymes (Alonso *et al*., 2004; Trueba, 2003). According to Wang *et al.* (2002) juice of noni has been consumed as a medicinal alternative for many diseases such as arthritis, diabetes, high arterial pressure, headaches, AIDS, cancer, peptic ulcer, and others.

Commercial noni juice is traditionally made by fermentation of noni fruits in sealed containers for 2 months at ambient temperature (Nelson, 2006). Fresh noni juice is made by direct squeezing of noni fruits (Nelson, 2006). Some noni juice is made by boiling noni fruits for hours. Since noni is considered a fruit with a bitter taste, the addition of sweet-tasting components allow changes in organoleptic aspects, favouring the commercialization of noni juice.

The use of Noni is gaining acceptance by the people of Ghana and considering the increase in commercialization of this product and the lack of scientific studies regarding the composition of noni juice and its beneficial implications in the treatment of diseases, the aim of the present study was to determine the total polyphenols content (TPC), and antioxidant capacity of commercial noni juice and some of its components. Noni juice as a product is now common in the Ghanaian markets. The juice is sold in various containers especially using empty plastic water containers.

  

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In a few of the products on the market, the label shows the address of the "manufacturer". None of the products indicates the composition of the contents. A scientific study of some of the composition Noni Juice would facilitate the understanding of the claims ascribed to the product.

## MATERIALS AND METHODS

### Profile of the Study Area

The study was carried out in Akim Oda. Akim Oda is a town in South Ghana and is the capital of the Birim Central Municipality in the Eastern Region of Ghana. In 2013, Akim Oda had a settlement population of 60,604 people. Akim Oda lies in the hilly country of south Ghana with rain forest vegetation in the Birim River basin. The climate of Akim Oda is semi-equatorial and wet with significant precipitation during the rainy season from April to June and again in September to November. A dry period is experienced between December to February.

### Research Design

The explorative and descriptive research designs were adopted for this study because small sample size was used, and also to describe and present qualitatively the knowledge base and the market potential of an emerging crop of value in Ghana.

### Data Collection Procedures

Laboratory and field research procedures were used to collect primary data.

### Extraction of noni juice

Forty (40) ripe fruits of noni as in Plate 2 were used in the extraction of the juice. The fermentation period was three (3) months before the filtration process to obtain the juice in clean plastic containers. The chemical analyses and phytochemical screening were performed on the extracted juice.

### Chemical Analyses

The Association of Official Analytical Chemists (AOAC) Official Method 999.10 of Atomic Absorption Spectrophotometry after microwave digestion was the method used in the determination of Zinc, and Copper. The AOAC Official Method 967.21 (2, 6-dichloroindophenol titrinetric method) was used in the determination of Vitamin C. In the case of Iron, colorimetric method based on 2, 2-bipyridyl was used in the determination. The determination of sulphur dioxide was based on Pearson's Composition and Analysis of Foods, 9th edition. Again in the case of the Tannins, the method used was based on Markkar, HPS; Blummer; NK Browy and

  

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Becker, 1993. Gravimetric of Tannins and their correction with chemical and protein precipitation. The above methods were employed at the Food Research Institute of the Council for Scientific and Industrial Research, Accra.

**Phytochemical Screening**

Tests were conducted to determine the presence or otherwise of the following phytochemicals: Flavonoids; Tannins; Saponins; and Alkaloids. The protocol for testing Ayurvedics, Sidha and Unani Medicines was the methodology applied. The phytochemical screening was conducted at the laboratory of the Ghana Standards Authority, Accra.

**Target Population and Sample Size**

Aryeetey (2002) defines population as the entire collection of items that is the focus of concern and can be subjected to statistical analysis. For the purpose of this study, the target population was those who patronize the noni juice at Akim Oda. A sample is a fraction of the total population that has been selected to represent the total population. Using a simple random sampling methodology, a sample size of thirty (30) was used for the field data collection.

## RESULTS AND DISCUSSIONS

**Results of Chemical Analysis**

Table 1 depicts the results of the chemical analyses that looked at tannins, iron, zinc, copper, sulphur dioxide and vitamin C.

**Table 1: Chemical analyses on noni juice**

| Parameter | Method | Unit | Results |
|---|---|---|---|
| Tannins | Based on Markar, HPS, M, Blummer, NK. Browy and K. Becker, 1993. Gravimetric of Tannins and their correction with chemical and protein precipitation. | mg/100ml | 9.94<br>9.94 |
| Iron | Based on 2,2-bipyridyl Colorimetric | mg/100ml | 0.65<br>0.80 |
| Zinc | Based on AOAC 9.1.08 modified | mg/100ml | 0.113<br>0.113 |

  

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| | | | |
|---|---|---|---|
| Copper | Based on AOAC 9.1.08 modified | mg/100ml | Not detected |
| Sulphur dioxide | Based on Pearson's Composition and Analysis of Foods 9th Edition | mg/100ml | 64.14<br>69.23 |
| Vitamin C | Based on Iodometric titrations | mg/100ml | 67.65<br>67.65 |

Limit of quantification Copper: 0.00001mg/100g

Source: Ghana Food Research Institute Laboratory. (2021)

**Minerals and Vitamin C**

The laboratory analyses indicated the presence of iron, zinc and sulphur while copper was absent. Vitamin C was present in high amounts. The results confirm what was done at reported at the C/T/A/H/R - Noni website (2006) which indicated the presence of the following in the juice: magnesium; iron; potassium; selenium; zinc; sulfur; ascorbic acid (vitamin C). Patel Swetal, & Krishanamurthy R (2013), in a review, provided some bio-active components in the noni juice and leaf powder in Table 2 that is favourably comparable to the results obtained in this research in terms of the presence of minerals and vitamin C.

**Table 2: Some active biochemical components of *Noni* juice & leaf powder**

| **Characteristics** | **Fruit juice** | | | **Leaf powder** |
|---|---|---|---|---|
| | **Chunhieng (2003)** | **Shovic and Whisler (2001)** | **European Commission (2002)** | **Leung *et al.*, 1972** |
| **Protein** | 2.5% | 0.4g/100g | 0.2–0.5% | 1 g/100g |
| **Lipid** | 0.30g/100g | 0.1–0.2% | – | 0.2 g/100g |
| **Glucose** | 11.9 ±0.2 g/l | –3.0–4.0% | – | – |
| **Fructose** | 8.2 ±0.2 g/l | – | 3.0–4.0% | – |
| **Potassium** | 3900 mg/l | 188 mg/100g | 30–150 mg/100g | – |
| **Sodium** | 214 mg/l | 21 mg/100g | 15–40 | – |

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| | | | | |
|---|---|---|---|---|
| | | | mg/100g | |
| **Magnesium** | 14 mg/l | 14.5 mg/100g | 3–12 mg/100g | 58 g/100g |
| **Calcium** | 28 mg/l | 41.7 mg/100g | 20–25 mg/100g | 50 g/100g |
| **Vitamin C** | – | 155 mg/100g | 3–25 mg/100g | 1 g/100g |

**Source: Patel (2013)**

The importance of minerals and vitamins to the human body cannot be underestimated and therefore their presence in the noni juice makes the juice to be preferred and consumed for ages.

**Results of Phytochemical Screening**

Table 3 shows the results of the quality evaluation or the phytochemical screening of the noni juice. The evaluation was limited to the presence or otherwise of Flavonoids, Tannins, Saponins, and Alkaloids.

**Table 3: Quality evaluation on noni juice**

| Test Conducted | Method | Unit | Results |
|---|---|---|---|
| Flavonoids | Protocol for testing Ayurvedic, Sidha and Unani Medicines | - | Present |
| Tannins | Protocol for testing Ayurvedic, Sidha and Unani Medicines | - | Present |
| Saponins | Protocol for testing Ayurvedic, Sidha and Unani Medicines | - | Present |
| Alkaloids | Protocol for testing Ayurvedic, Sidha and Unani Medicines | - | Present |

**Source: Ghana Standards Authority Laboratory, 2021**

According to Group, (2016) phytochemicals offer incredible health benefits. Phytochemicals are usually found in fruits and vegetables and a diet high in fruits and vegetables is especially beneficial to human health and can even reduce the risk of many serious health conditions. Phytochemicals, being present in the noni juice, accounts for its consumption for health benefits. The tannins have anti-mutagenic and antioxidative properties that are important in protecting cellular oxidative damage, including lipid peroxidation. Tannins have also been reported to exert

  

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other physiological effects, such as accelerating blood clotting, reduce blood pressure, decrease the serum lipid level, produce liver necrosis, and modulate immune responses. Again tannins have anti-microbial properties. According to Kittakoop, Mahidol, and Ru (2014), alkaloids have a wide range of pharmacological activities including antimalarial (e.g. quinine), antiasthma (e.g. ephedrine), anticancer (e.g. homoharringtonine), cholinomimetic (e.g. galantamine), vasodilatory (e.g. vincamine), antiarrhythmic (e.g. quinidine), analgesic (e.g. morphine), antibacterial (e.g. chelerythrine), and antihyperglycemic activities (e.g. piperine).

**Table 4: scientific classification of Noni**

| Class/Rank | Description |
|---|---|
| Kingdom | Plantae |
| Clade 1 | Angiosperm |
| Clade 2 | Eudicots |
| Clade 3 | Asterids |
| Order | Gentianales |
| Family | Rubiaceae |
| Genus | *Morinda* |
| Species | *citrifolia* |

**Source: www.wikipedia.org accessed June, 2021**

Flavonoids are commonly found in apples, apricots, beans, broccoli, cherry tomatoes, chives, cranberries, kale, leeks, pears, onions, red grapes, sweet cherries, and white currants. They can help reduce the risk of cardiovascular disease and lower blood pressure. Dark chocolate is an excellent source of flavanols. Flavonoids are important antioxidants and promote several health effects. Aside from antioxidant activity, these molecules provide the following beneficial effects: Anti-viral; Anti-cancer; Anti-inflammatory; Anti-allergic (Robertson, 2014).

Saponins are naturally occurring plant glycosides; they possess soap-like qualities and produce lather when mixed with water. Saponins have a unique chemical structure that produces foam when mixed with water, just like a detergent. And, also like detergent, saponins can bind with water as well as fats and oils. This means that, in the digestive tract, saponins produce emulsification of fat-soluble molecules. Specifically, saponins bind to bile acids and help eliminate them from the body, preventing cholesterol from being reabsorbed. The cholesterol-lowering effect of saponins has been known for decades. (Group, 2016). esterol absorption. A separate study found that giving a certain saponin extract to rats with high cholesterol reduced “bad” (LDL) cholesterol without affecting “good” (HDL) cholesterol. In nature, plants rely on

  

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saponins as a mechanism to fight parasites. Similarly, when consumed by humans, saponins provide a similar defence against harmful organisms. (Group, 2016).

**Results of Field Survey**

The field survey indicated all the respondents were alpha-numeric literates, see Figure 1 below. The information about noni will spread widely among the literate community that will enhance the popularity of the product.

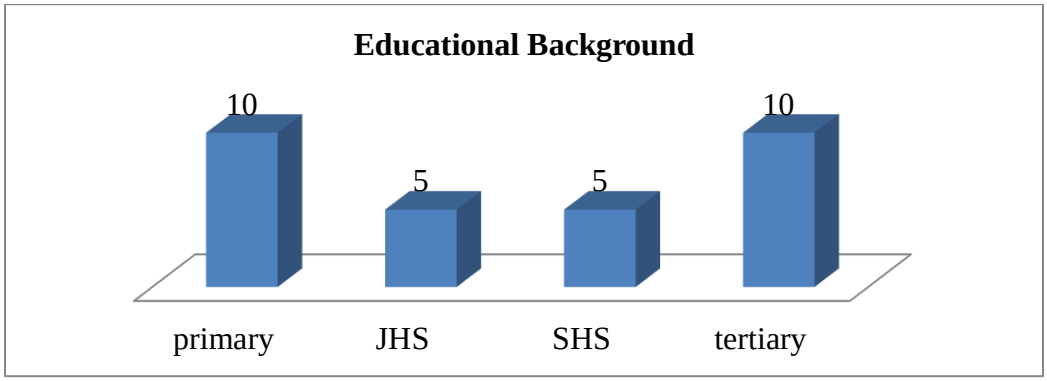


**Figure 1: Educational background of respondents.**

**Source: Field Survey, (2021)**

The literacy level of the respondents corresponds favourably to their awareness of the noni. However, from Figure 2, noni is fairly new among the respondents since most of them are aware of the noni within one year and six months.

**Knowledge profile of Respondents**

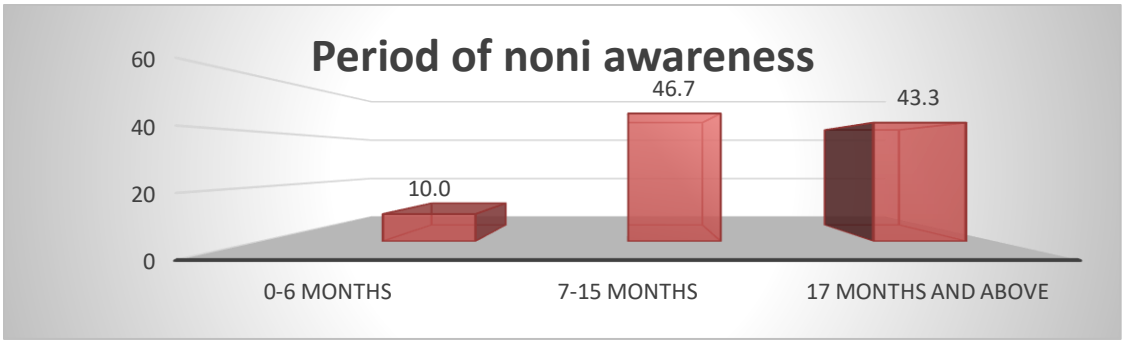


**Figure 2: Period respondents are aware of noni**

**Source: Field Survey, (2021)**

  

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The awareness of the noni juice reflects in respondents' use of noni juice mainly for medicinal purposes. The treatment to which the noni juice is ascribed also reflects the literacy level of the respondents. Figures 3 and 4 ascertain the levels of knowledge by the respondents. The findings confirm the noni juice is a popular herbal medicine as reported by Wang *et al.*, (2002); and Zin, Hamid, and Osman, (2002).Singh (2012), in a scientific literature review, validated the nutritional and therapeutic properties of the noni juice. Also, Swetal and Krishanamurthy (2013) indicated that Noni fruit juice is recently accepted as a novel food in the European Union. Nowaday *Noni* juice is in high demand as an alternative medicine for various illnesses and it helps to live along and healthy life".

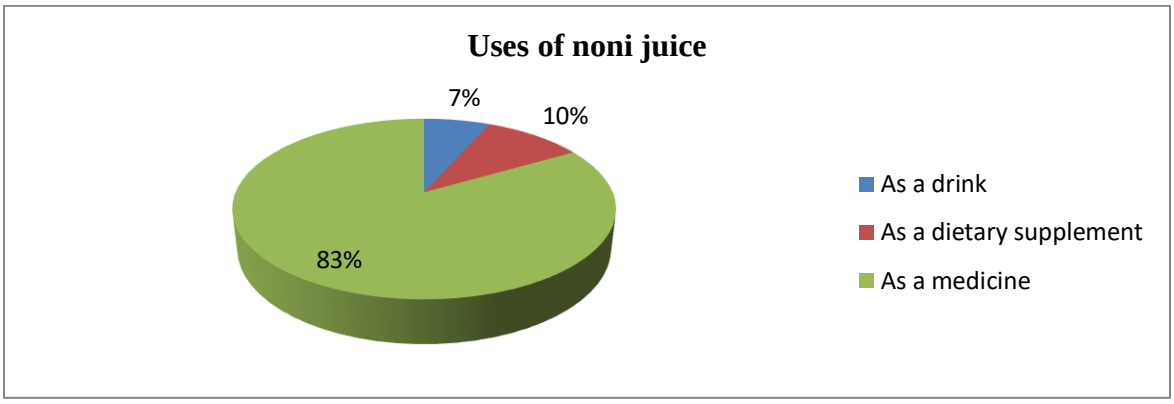


**Figure 3: Respondents' uses of noni juice**

**Source: Field Survey, (2021)**

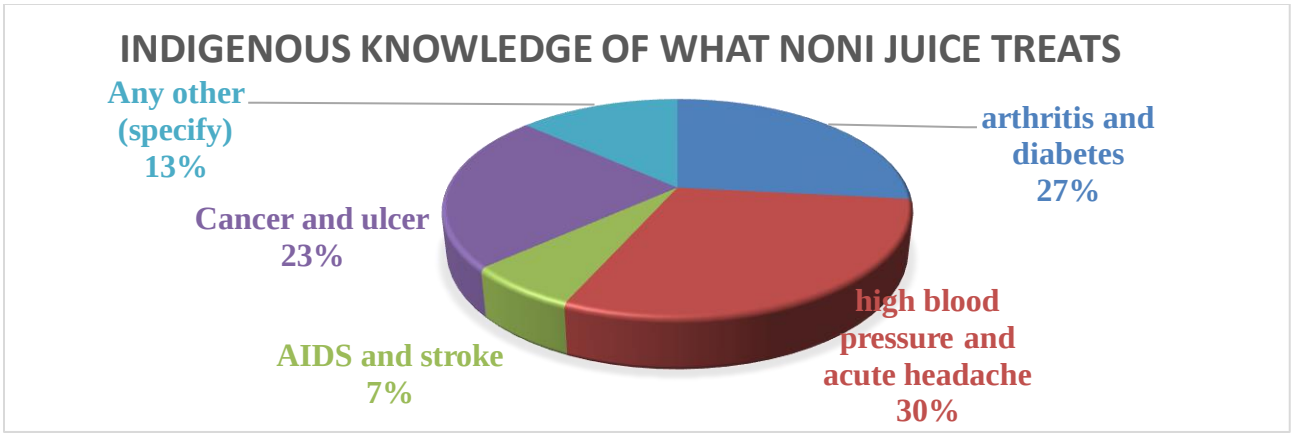


**Figure 4: Indigenous perception of the treatment potentials of noni**

**Source: Field Survey, (2021)**

  

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**Marketability and Profitability of noni juice**

Respondents (90%) indicated that the noni sells very much and the profit made is also very good. Since there is a high level of noni knowledge among those who patronize the product, there is little doubt about the high level of marketability and profitability. Apparent the 10% of the respondents as in Figure 5 below were not too much in the commercialization of the product.

Such a perspective and emerging noni value chain confirms what was stated by Eliosbel Márquez, Débora Castro, Margarita Nuñez, and José Luis Rodriguez (2011) thus "In the last few years the consumption of products of this fruit increased notably in the United States, Japan and Europe. The FAO/WHO combined report (2008) on the food standards programme estimated a noni market of 400 million USD in 2001, while the estimate in 2006 had increased to 2000 million USD, which made it the fastest-growing market in the global health products sector. Noni juice has been accepted in the European Union as a novel food and the fruit was evaluated as to the safety and approved for human consumption".

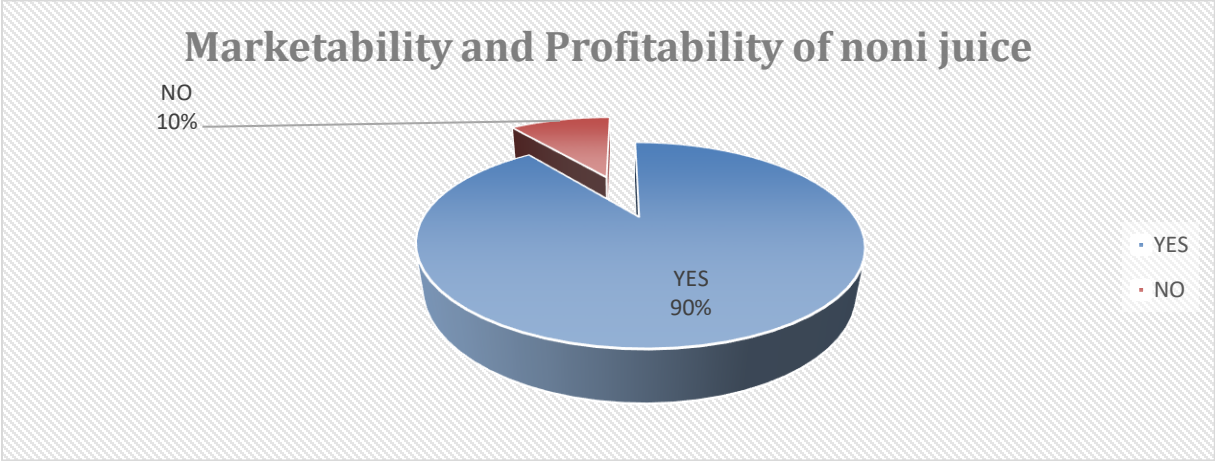


**Figure 5: Market potential and perceived profitability of noni juice**

**Source: Field Survey, (2021)**

**KEY FINDINGS**

The *Morinda citrifolia* L. (Noni) has been used as an indigenous medication in Polynesia for ages. Such information has of recent years trickled to the Ghanaian community and the value chain of noni is becoming popular. The minimal scientific knowledge in Ghana about noni is a source of worry.

  

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This research sought to bridge the indigenous and scientific knowledge gap. Laboratory analyses were conducted on the fermented noni juice. Also, a field survey was conducted on the indigenous knowledge base about the plant, its products and value additions. The results of the laboratory analyses indicated the presence of minerals and especially Vitamin C; and phytochemicals in the fermented juice. The field survey indicated indigenous knowledge of the plant and its products; high marketing potential; and high-value chain potential; however with minimal scientific knowledge available.

## CONCLUSION

The chemical composition of Vitamin C; and phytochemicals in the fermented juice confirming work done by other Researchers outside Ghana as well as the efficacy of the noni juice in a variety of therapeutic properties. Indigence of the study area possess a huge knowledge of the plant and its products; high marketing potential; however with minimal scientific knowledge available.

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**Plate 6: Seeds of Noni**