EFFECTS OF GROUND RAW CANDLENUT (*Aleurites moluccana (L.)* Willd) KERNEL ON GROWTH PERFORMANCE IN QUAIL

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LIVESTOCK PRODUCTION PROGRAMME
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LIVESTOCK PRODUCTION PROGRAMME
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UNIVERSITI OF MALAYSIA SABAH
2017

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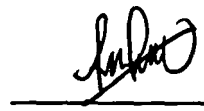

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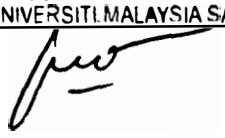

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EFFECTS OF GROUND RAW CANDLENUT (*Aleurites moluccana (L.)* Willd*)* KERNEL ON THE GROWTH PERFORMANCE OF QUAIL

ABSTRACT

The experiment was carried out to determine the effects of ground raw candlenut kernel at different levels (%) on the growth performance of broiler quails in the Poultry Unit at Faculty of Sustainable Agriculture, Universiti of Malaysia Sabah, Sandakan campus. The birds were allocated into four treatment groups, each replicated five times, consisting of 5 birds each in a Completely Randomized Design (CRD). Started from day 21 onwards, the birds were fed with either one of the four dietary treatments (Table 1.2), namely; (T1) basal diet (BD); (T2) basal diet + 2.5g/kg ground raw candlenut kernel (0.25%); (T3) basal diet + 5g/kg ground raw candlenut kernel (0.50%); and (T4) basal diet + 10 g/kg ground raw candlenut kernel (1%). All diets have been isonitrogenous formulated to meet or exceed the NRC (1994) requirement, and was offered in the mash form. Parameters such as body weight (g), daily weight gain (g), feed intake (g), feed conversion ratio (FCR) and mortality of broiler quails were assessed in this experiment. Proximate analysis and fatty acid composition were also analyzed in this experiment. All the data collected were arranged in the form of Microsoft Excel 2010 as the basement data and the data were used again in the form of arrangement data by using Statistical Analysis System (SAS) v9.4. The growth performances were not significantly ($p>0.05$) affected by the ground raw candlenut kernel. The fatty acid composition analyzed were also had no significant ($p>0.05$) effects by the ground raw candlenut kernel. However, there were significant differences ($p<0.05$) on proximate analysis which include dry matter (%), ash (%), crude fibre (%) and crude fat (%) except for gross energy (MJ/kg). The best treatment was shown in T4 which has the least value of feed conversion ratio (FCR) which indicates a better feed efficiency compared to other treatments.

KESAN MIL ISIRUNG BUAH KERAS (*Aleurites moluccana (L.) Willd*) MENTAH TERHADAP PRESTASI PERTUMBUHAN PADA PUYUH

ABSTRAK

Kajian ini telah dijalankan bagi menentukan kesan mil isirung buah keras mentah yang diberi dalam tahap yang berbeza terhadap prestasi pertumbuhan puyuh pedaging di Unit Poultri yang terletak di Fakulti Pertanian Lestari, Universiti Malaysia Sabah, kampus Sandakan. 100 ekor puyuh telah diasingkan kepada 4 kumpulan rawatan, setiap rawatan direplikasi sebanyak 5 kali, dan mempunyai 5 ekor puyuh disusun secara Rekabentuk Rawak Lengkap. Bermula dari hari ke-21 hingga seterusnya, puyuh-puyuh tersebut telah diberi makan salah satu daripada empat rawatan pemakanan (Jadual 1.2), iaitu (T1) diet basal (DB); (T2) diet basal + 2.5g/kg mil isirung buah keras mentah (0.25%); (T3) diet basal + 5g/kg mil isirung buah keras mentah (0.50%); and (T4) diet basal + 10 g/kg mil isirung buah keras mentah (1%). Semua makanan telah dirumuskan untuk memenuhi atau melepasi keperluan NRC (1994), dan disediakan dalam bentuk serbuk. Parameter seperti berat badan (g), berat badan setiap hari (g), pengambilan makanan (g), nisbah pertukaran pemakanan (FCR) dan kadar kematian puyuh pedaging telah dinilai dalam eksperimen ini. Analisis proksimat dan komposisi asid lemak juga dianalisis dalam eksperimen ini. Semua data yang dikumpul akan disusun dalam bentuk Microsoft Excel 2010 sebagai data susunan asas dan data akan digunakan lagi dalam bentuk data susunan akhir dengan menggunakan '*Statistical System Analysis* (SAS)' v9.4. Prestasi pertumbuhan tidak ketara ($p > 0.05$) dipengaruhi oleh mil isirung buah keras mentah. Komposisi asid lemak dianalisis juga tidak mempunyai ($p > 0.05$) kesan yang ketara oleh mil isirung buah keras mentah. Walau bagaimanapun, terdapat perbezaan yang ketara ($p < 0.05$) pada analisis proksimat termasuk bahan kering (%), abu (%), serat kasar (%) dan lemak kasar (%) kecuali tenaga kasar (MJ / kg). Rawatan yang terbaik telah ditunjukkan dalam T4 yang mempunyai nilai terendah dengan nisbah penukaran makanan yang menunjukkan keberkesanan makanan yang lebih baik berbanding rawatan lain.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

%	Percentage
ALA	Alphalinolenic Acid
ANOVA	Analysis of Variance
Ca	Calcium
Cal	Calories
Cm	Centimeter
CP	Crude Protein
CRD	Completely Randomized Design
DBH	Diameter at Breast Height
DM	Dry Matter
FCR	Feed Conversion Ratio
G	Gram
kJ	Kilojoules
LA	Linoleic Acid
LSD	Least Significant Difference
m	Metre
mm	millimetre
Mg	Milligram
ME	Metabolize Energy
P	Phosphorus
OA	Oleic Acid

LIST OF FORMULAE

CHAPTER 1

INTRODUCTION

1.1 Background of Project

Among different types of poultry farming, quail production is a minor venture and little attention has been paid to the management and nutritional needs of modern strains of quails. However, quail production is getting increasingly popular as either a valuable source of protein for human or providing game bird for hunting around the world. It is blessed with the unique characteristics of fast growth, early sexual maturity, high rate of egg production, short generation interval and shorter incubation period that makes it suitable for diversified animal agriculture. They are fairly resistant to disease, and impart less worry for vaccination. Because of the low volume, low weight, less feed input and space requirements, the commercial quail farming for table egg and meat production can be started with much lower capital investment as compared to chicken and duck with almost the same profit margin. With shorter reproduction cycle and earlier marketing age, it offers fast monetary circulation ultimately yielding quicker returns. For example, growing Japanese quail becomes widespread in some parts of Europe (e.g., Spain and France) and Asia (e.g., Japan) because of meat and egg (Minvielle, 2004). This shows that commercial production of quail breeds underwent unequal development across the world (Minvielle, 2004).

Aleurites moluccana (L.) Willd., also known as candlenut, is one of the world's great domesticated multipurpose trees. It is an evergreen or partly deciduous, medium or large tree, up to 15-24m, with wide spreading branches. It has a grey trunk; heart-shaped or ovate-lanceolate, leathery, bright green leaves, 7 to 12 inches long (17-30 cm) and 6 inches wide (15 cm), with conspicuous veins and the young foliage has a silvery, powdered appearance (Scott and Craig, 2000). It is native to the Indo-Malaysia

region and was introduced throughout the Pacific islands in ancient times. In Indonesia, it has long been grown for subsistence and commercial purposes, sustaining people's everyday lives, especially in the eastern part of the country. The species can be used for various purposes; the seeds provide material for lighting, cooking and pharmaceuticals, and the trunk is used for timber. The kernel contains about 60% of oil and burns easily with a smoky flame. It justifies its use at one time as a primitive candle by some native people of the pacific, who stung the kernels together on sticks (Elevitch and Manner, 2006).

The candlenut oil is similar to linseed or Tung oil and can be used in making paints, varnishes, soap, and as a wood preservative for boats (Morrison and Roderick, 2002). The candlenut oil cake is high in nitrogenous content and makes a useful fertilizer for agricultural purposes. Like other oilseeds, candlenut is a potentially valuable source of fatty acid which is rich in alphalinolenic acid (ALA), linoleic acid (LA) and oleic acid (OC). Kernels when roasted and cooked are considered edible; may be strung as candle nuts. After removing the hard outer coat, the seed is pounded and eaten as a sauce. In per 100 g, the seed is reported to contain 626 calories, 63 g fat, 19 g protein, 8 g total carbohydrate, 7 g water, 3 g ash, 200 mg phosphorus, 80 mg calcium, 2 mg iron, and 0.06 mg thiamine. The significance of animal protein in sufficient and balanced nourishment is considerable for the human health with respect to the physical and mental progress. Meeting the demand, for animal protein requirement, calls for intensified production of animals, with prolific tendency, short period of gestation, rapid growth and short generation interval. The Japanese quails fall within this description and selected as animal of choice in increasing animal protein sources. Therefore, the use of candlenut's kernel as the additional supplement in feeding may affect the growth performance of the broiler quails whether it will increase or decrease based on the feed formulation prepared for the quail's feeds.

1.2 Justification

The term 'quail farming' means, raising quails commercially (like other poultry birds) for the purpose of profitable eggs and meat production. As far as we have experienced, quail farming business is very easy, profitable and entertaining. It's very easy to maintain a quail farm, because quails are among the smallest species of poultry birds. The Japanese scientists first tamed the wild quails and revealed the ways

to raise them as domestic birds. Commercial quail farming in Japan has spread tremendously.

However in Malaysia, especially in Sabah, the demands for quail's meat are not high compared to the other poultry's meat. The reasons are the people here are not disclosed on the nutritional value and protein content in quails. Meat and eggs of quail are very tasty and nutritious. Quail eggs are very nutritious than other poultry eggs. Because quail eggs contain comparatively more protein, phosphorus, iron, vitamin A, B1 and B2. The oil from the candlenut is an irritant and is used on the scalp to promote hair growth. The pulped seed kernels are used in poultices to relieve headaches, fevers, swollen joints and sores and ulcers on the skin.

In Java the bark decoction is given for dysentery, while the hot leaves are used for headaches and gonorrhoea for which purposes they are applied topically to the body. The leaves and bark have been found to have antiviral and antibacterial properties, while the methanol extract of the leaves has hypolipidemic effects. The leaves have pain-killing properties believed to be due to their flavonoids content. It is rich in vitamins A, B and C and the omega-3 fatty acids which plays a crucial role for normal growth and development. There is increasing support for omega-3 fatty acids in protecting against fatal heart disease and it is known that they have anti-inflammatory effects, which may be important in this and other diseases. There is also growing interest in the role of omega-3 fatty acids in the prevention of diabetes and certain types of cancer. (Lunn and Theobald, 2006)

The nuts from the tree may be used in cooking as a substitute for macadamia nuts, but should not be eaten raw as they contain saponins and other toxic substances. Therefore, the effectiveness of the ground raw candlenut (*Aleurites moluccana*) kernel will be tested whether it can increase the growth performance of the quails or do not give any effect to the growth performance of the quails. It will increase the demands for quail with highly nutritious meat to the local and also worldwide market.

1.3 Objectives

To determine the effects of ground raw candlenut kernel at different levels on body weight, daily weight gain, feed intake, feed conversion ratio and mortality of broiler quails at grower-finisher stage.

1.4 Hypothesis

Ho: There are no significance differences between the effects of ground raw candlenut kernel at different levels on growth performance in broiler quails at grower finisher stage.

Ha: There are significance differences between the effects of ground raw candlenut kernel on the growth performance in broiler quails at grower finisher stage.

CHAPTER 2

LITERATURE REVIEW

2.1 Quails

2.1.1 Taxonomic and History of Domestication

Quail have been farmed since ancient times. The earliest known representation of the quail can be found in the Egyptian hieroglyphics (2000 B.C.), where the quail represents the letter "W" in the alphabet (Shanaway, 1994). The Japanese quail is a member of the pheasant (Phasianidae) family and is considered to be different species from the common quail (Johnsgard and Paul, 2009). Quail meat has been known for centuries and there are even Biblical quotations of their use as a meat source (Boni *et al.*, 2010). During the last decade, quail has attained economic importance as an agricultural species producing eggs and meat that are enjoyed for their unique flavour (Kayang *et al.* 2004). In fact, quail are found in all continents. Several lines, breeds and varieties have been developed for different production purposes (Maiorano *et al.*, 2012).

Around the world, there are 20 types of wild and about 70 domestic quail breeds or strains, including laboratory and commercial quail. Although all domestic quails derive from wild strains, many obvious differences are evident today. However, how these differences occurred and which wild population was the first to be domesticated, remains unclear (Chang et al., 2005). The Japanese quail is native to the eastern Palaearctic (Japan, Eastern Siberia, Mongolia, North China, and Korea) and migrates each year to the south of China (Hoyo *et al.*, 1994). The domestic Japanese

quail, however, has lost all migratory behaviour, in contrast to its wild form. Japanese quails have been reproduced in captivity for centuries and domesticated. Wild Japanese quails are mainly distributed throughout East Asia including northern Mongolia, Sakhalin Island and the Baikal and Vitim regions of Russia, north-eastern China, Japan, North Korea and South Korea. Some populations in Japan are resident, but most birds migrate south, wintering in southern China, Laos, Vietnam, Cambodia, Myanmar, Bhutan and north-eastern India (Hoyo *et al.*, 1994). There are also introduced populations in Italy and Hawaii (USA). No reliable population estimate exists, and although the species was previously considered to be fairly common in China, declines appear to have occurred in Laos and Japan, and there are fears that the species has undergone a significant decline overall.

The evolutionary relationships and taxonomic status of European and East Asian populations of quail (*Coturnix coturnix*) are controversial. European and Far Eastern Japanese quails have been considered as distinct, albeit closely related allospecies, or as two subspecies, namely the Common quail *Coturnix coturnix* and the Japanese quail *Coturnix japonica* (Barilani *et al.*, 2005). Japanese quail and Common quail have allopatric distributions in Europe, Maghreb and western Asia (Common quail), and in eastern Asia (Japanese quail), except for sympatric breeding areas in the Baikal (Russia) and Kentei (Mongolia) regions, where they could hybridize (Barilani *et al.*, 2005; Puigcerver *et al.*, 2007).

2.1.2 Benefits of Quails Production (Meat and Eggs)

Quail farming is more profitable than other poultry. Quails has various benefits such as: quail birds mature earlier; they start laying eggs after 5-6 weeks; they lay a greater number of eggs 280-300 in a year; their eggs takes about 16 to 18 days to hatch; they have high immunity against diseases; they are poor feeders and they require small floor space (Onyewuchi *et al.*, 2013). Meat and eggs of quail are very tasty, delicious and nutritious and are source of high quality protein (Bakoji *et al.*, 2013). There are variety of chicken, duck, roe, and caviar, but by a wide margin the egg most often humanly consumed is the chicken egg, typically unfertilized. Besides, a lot of people especially in Asian countries consume quail eggs (or Kai Nok Kra Tha, Thai name) which previous study reported that quail eggs are packed with vitamins

and minerals even with their small size, their nutritional value is three to four times greater than chicken eggs.

Regular consumption of quail eggs helps fight against many diseases which is a natural combatant against digestive tract disorders such as stomach ulcers. Quail eggs strengthen the immune system, promote memory health, increase brain activity and stabilize the nervous system. Quail production is gaining popularity in the developing countries due to its role in bridging the protein malnutrition, economic empowerment of the resource poor segment of the society and also fits well in the farming systems commonly practiced. Quail production is practiced at levels ranging from subsistence to large scale commercial operations (Kingori, 2011).

According to heritability of carcass traits (ranging from 0.08 and 0.55) estimated in many studies, carcass composition in Japanese quail can be significantly improved through selection (Lotfi *et al.*, 2011). In fact, poultry breeders have predominantly focused on selection for increased breast muscle yield in response to the consumers' demand for processed poultry products and correspondingly lees for whole ready to roast carcasses (Zerehdaran *et al.*, 2012). Another important issue for the meat poultry industry is the reduction of abdominal fat, which is regarded as the main source of waste in birds.Not only is abdominal fat a loss, but it also represents an added expense for the processing effluent treatment in further processing.

2.1.3 Japanese Quail as an Experimental and Model Animal

The Japanese quail was first reported as a useful research model in 1959 by Padgett and Ivey, who noted its practicality as a laboratory animal for avian developmental studies (Huss *et al.*, 2008). The low maintenance cost associated with its small body size (80 – 300 g) coupled with its early sexual maturity, short generation interval and high egg production; render it an excellent laboratory animal (Kayang *et al.*, 2004). It has thus been used extensively in many studies including behavioural, developmental, physiological (Balthazart *et al.*, 2003), genetic and biomedical researches. For example, both embryos and adult Japanese quail are widely used for the studies of vertebrate physiology and diseases that affect human health. Knowledge on

myogenesis, vasculogenesis, angiogenesis, skeletogenesis, wound healing, virology and teratology has progressed substantially as a result of studies on avian embryos (Huss et al., 2008). In addition, quail was used as a model to investigate age-related disease. The Japanese quail's short lifespan (females live 2.5 - 3 years, whereas males live 3-5 years; Ottinger, 2001) combined with its physiological which is similar to humans have made this bird an ideal model for studies in immunology, endocrinology and reproductive biology.

The Japanese quail also helps in studies of the reproductive toxicology of chemical compounds and the effects of environmental endocrine disruptors (Huss *et al.*, 2008). Quails are increasingly being used as a comparator organism in cell-based investigations and are still heavily utilized in quail-chick chimerical studies for elucidating cell fates during development (Ainsworth *et al.*, 2010). Recently, the quail has proven to be a successful model for the production of a transgenic avian with several advantages. The hardy nature of its embryo limits mortality during introduction of the transgene into the blastoderm. The quail's short embryonic development period of 16 days, rapid advancement to sexual maturity and prodigious egg production all combine to substantially shorten the time needed to produce a stable line of transgenic avians when compared with the chicken (Huss *et al.*, 2008).

2.2 Candlenut (*Aleurites moluccana L.*)

2.2.1 Taxonomy

Aleurites moluccana (L.) Willd., which also known as candlenut, is one of the world's great domesticated multipurpose trees. It is native to the Indo-Malaysia region and was introduced throughout the Pacific islands in ancient times. In Indonesia, it has long been grown for both subsistence and commercial purposes, sustaining people's everyday lives, especially in the eastern part of the country. The species can be used for various purposes; the seeds provide material for lighting, cooking and pharmaceuticals, and the trunk is used for timber. *A. moluccana* is distributed across almost all islands in the Indonesian archipelago. Despite this wide distribution, and although the species is easy to grow, it has not been planted in large-scale plantations. It is extensively cultivated in home gardens, and in and around farms. The main *A. moluccana* cultivation areas in Indonesia are in the provinces of North

Sumatra, West Sumatra, South Sumatra, Bengkulu, Lampung, West Java, West Kalimantan, South Kalimantan, East Kalimantan, Bali, South Sulawesi, Maluku and East Nusa Tenggara. The total cultivation area of *A. moluccana* in Indonesia has been reported to be 205 532 ha (Directorate of Perennial Crop Cultivation, 2008). According to the 2003 agricultural census, as reported by the Ministry of Forestry and the National Statistics Agency (2004), the provinces with the highest number of *A. moluccana* trees planted by smallholders are East Nusa Tenggara and North Sumatra, with more than 2 million *A. moluccana* trees reportedly planted by households in each of these provinces.

The taxonomy is described in; Botanical name: Aleuritesmoluccana (L.) Willd.; Family: Euphorbiaceae; Subfamily: Crotonoideae; Synonyms: *Aleurites javanica* Gand., *Aleurites remyi* Sherff, *Aleurites triloba* Forster & Forster f., *Camirium moluccanum (L.)* Ktze., *Croton moluccanus* L., and *Jatropha moluccana* L. Common names in other countries are such as candlenut, candleberry, varnish tree, Indian or Belgaum walnut (England); lauci, nggerenggere, sikeci, sikeli, sikethi, toto, tuitui, nozda India (Portugal); lama (Samoa); arbollloron, avellano, avellanocriollo, nogal de la India, nuez (Spain); kandeltri (Vanuatu); lerit, nwa, nwazet (Creole); ragaur (North Carolina) (Elevitch and Manner, 2006).

2.2.2 Botany

Aleurites moluccana is a medium-sized tree with a large spreading crown that can reach 20 m in height and 0.9 m trunk diameter (diameter at breast height; DBH), although it typically grows to 10–15 m in open areas. Crooked trunks and irregular, wide, spreading or pendulous side branches are typical. In narrow valleys, *A. moluccana* usually has a branchless trunk and achieves its greatest height. The bark is grey-brown in colour, and fairly smooth with fine vertical lines. It has very distinctive leaves, which are 3- to 5-nerved from the base, alternate and simple, with entire, wavy margins. The leaf blades are 10–20 cm long with 2 glands at the junction of the leaf base and petiole that secrete a sweetish sap. Younger leaves are usually simple and deltoid to ovate in shape. The upper surface of young leaves is whitish with a silvery gloss, becoming dark green with age. The underside is rusty stellate-pubescent when young (having a hairy glossy indument) (Elevitch and Manner 2006).

The flower is monoecious, that is, it has both male and female flowers on the same tree. The flowers are greenish-white and fragrant and are arranged in 10–15 cm terminal panicle cymes, with many small male flowers surrounding the female flower. The corolla is whitish with 5 free petals, dingy white to creamy in colour, oblong in shape and up to 1.3 cm in length. The fruit is green to brownish in colour and is a laterally compressed. Each fruit usually contains 2 or 3 seeds, but 1 seed may be found in male fruit. These seeds are edible when roasted. The seeds are contained within a hard, black, rough shell that is elliptical in shape and about 2.5–3.5 cm long (Elevitch and Manner, 2006).

2.2.3 Distribution

Aleurites moluccana has a large geographical distribution. This species is native to Indo-Malaysia (including Brunei, Cambodia, China, Cook Islands, Fiji, French Polynesia, Indonesia, Kiribati, Laos, Malaysia, Marshall Islands, Myanmar, New Caledonia, Norfolk Island, Papua New Guinea, Philippines, Samoa, Solomon Islands, Thailand, Tonga, Vanuatu and Vietnam). The tree has also been successfully introduced in Antigua and Barbuda, Bahamas, Bangladesh, Barbados, Brazil, Cuba, Dominican Republic, Grenada, Guadeloupe, Haiti, India, Jamaica, Japan, Kenya, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Sri Lanka, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago, Uganda, United States of America and Virgin Islands (US) (Elevitch and Manner 2006).

2.3 Uses and Nutritional Value of Candlenut (*Aleurites moluccana*) Plants and Its Kernel

The fruits and leaves of this plant are used in traditional Asian medicine for the treatment of headache, morning sickness, fever, inflammation, gonorrhoea, and to lower cholesterol (Pedrosa *et al.*, 2002; Ostraff *et al.*, 2000). *Aleurites moluccana* extracts showed anti-bacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Locher *et al.*, 1995). The kernel contains about 60% of oil and burns easily with a smoky flame. It justifies its use at one time as a primitive candle by some native people of the pacific, who stung the kernels together on sticks (Elevitch *et al.*, 2006). The candlenut oil is similar to linseed or tung oil and can be used in making paints, varnishes, soap, and as a wood preservative for boats

(Morrison and Roderick, 2002). The candlenut oil cake is high in nitrogenous content and makes a useful fertilizer for agricultural purposes. The purging effect allows the nut to be utilized as a laxative. The oil is also used as hair stimulant or additive to hair treatment systems. The timber is silvery white, very plain and, although light and soft, is fairly tough. When draining boards were of wooden construction and kitchen shelves were often left unpainted. Candlenut was popular for the purpose, because it retained its whitish colour for a long time.

Several parts of the plant have been used in traditional medicine in most of the areas where it's native. The pulped kernels or boiled leaves are used in poultices for headache; fevers, ulcers, swollen joints, and gonorrhoea. In ancient periods the nuts were burned to provide light. The nuts were stung in a row on a palm leaf midrib, lit one end and one by one every 15 minutes or so. This led to their use as a measure of time, one could instruct someone to return home before the second nut burned out (Krauss and Beatrice, 1993). Fishermen made use of the nuts where they would chew the nuts and spit them on the water to break the surface tension and remove reflections. Dead wood of candlenut is eaten by a larva of coleopteran called *Agrionome fairmaire*, the larva is eaten by some people. An average tree may produce 100-150 lbs of nuts a year, yielding about 35-45% of oil. When planted on a commercial scale in certain subtropical climate, it said to give 5 tons of seed (1800lbs oil) per acre of mature trees (Dunford *et al.*, 2002).

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