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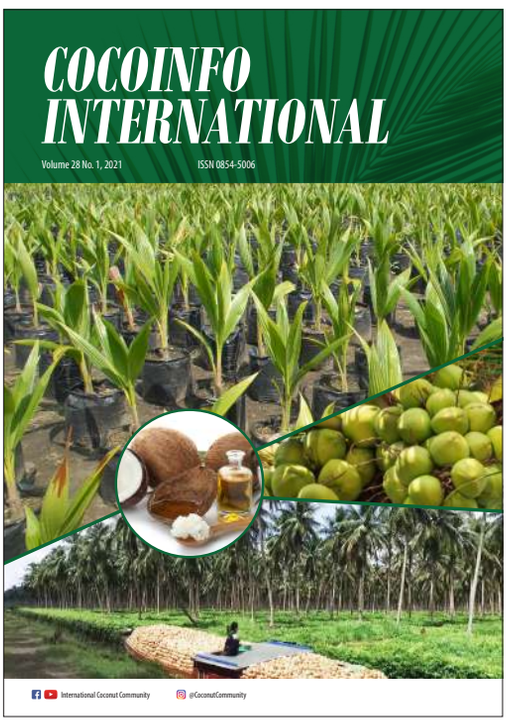

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International Coconut Community

STAY HEALTHY & PROFILIC WITH COCONUTS

A A variety of sugary foods and drinks are traded globally and consumed by many people around the world. Several studies have reported the higher prevalence of type 2 diabetes which is mostly diet-related disease among people. According to the World Health Organization (WHO), millions of people are living with diabetes. We need to protect our people, family, and children from this type of disease. To address this issues, low-sugar or sugar-free and synthetic sugar products are traded. However, some of these products are considered unhealthy. Foods and drinks that are low in Glycemic Index (GI) are considered reduce postprandial glycemia, and so resulting in more stable glucose concentration. Coconut sugar was reported to have a GI value of 35 while sugar produced from other raw materials have higher GI of around 42 to 82. This suggest that coconut sugar is a healthier sugar source. In addition, coconut sugar is higher in minerals (Fe, Mg, K, P, Mn) and vitamins such as B6, B2, B1 and B3. Coconut sugar is processed from the sap collected from the young coconut inflorescence, has a superior taste and the texture and tastes are like brown sugar.

Since inflorescences are tapped, therefore the nuts will not be produced from the inflorescence, unless they only tap a few out of the total more than 12 inflorescences produced each year. For coconut sugar production, it is recommended to use dwarf or hybrid coconuts given the height of the palms are shorter the tall type, and to facilitate easy climb and provide more opportunity for women to collect coconut sap or neera and cook it as a source of healthy food and income for the family. So, a great advantage of coconut sugar production is that it can be undertaken by MSMEs, including cooperatives and women.

Coconut sugar is traditionally used in local foods and beverages, and is processed in sauces, bakeries, and the cosmetics industry. High demand from local and global markets in the United States, New Zealand, South Africa, Australia, France, Canada, Norway, and other countries has encouraged the coconut producing countries to meet the demand by producing high quality of coconut sugar and increasing coconut production to fully fulfill local and global markets. Several challenges in the coconut sugar supply chain are insufficient raw materials due to competition with other products, adulteration, and quality consistency among producers. Replanting old, and unproductive coconut palms and planting desirable coconuts are required for sustainable raw material availability and meet the growing demand.

The main producers of coconut sugars are the Philippines, Brazil, Indonesia, and Thailand. The outlook for the coconut sugar in the next few years will be increased at a CAGR of about 5.6% due to demand for alternative healthier sugar, an increase in the diabetic population, and a preference for plant-based healthy foods and beverages. Other coconut products such as water, nata de coco, coconut milk, coconut flour, desiccated coconut and VCO are expected to grow by of 18.6%, 21.3%, 9%, 6.6%, 3.2% and 2.4% from 2020 to 2025. Hence, all coconut producing countries have great opportunities to optimize added value, provide jobs, generate more income, reduce poverty, and stimulate economic growth.

DR. JELFINA C. ALOUW
Executive Director
Editor-in-Chief

THE CHALLENGE OF DETECTING ADULTERATION IN VIRGIN COCONUT OIL

Fabian M. Dayrit[1], Grace B. Tantengco[1], Philip Gabriel M. Opao[1], Lolita G. Lagurin[1] & Mark Joseph M. Garrovillas[1]

As a product increases in value, the threat of adulteration increases in proportion. Today, virgin coconut oil (VCO) is becoming a sought-after product due to its numerous health benefits, use in cosmetics, and recently, its efficacy against COVID-19.

The world market for VCO is projected to reach roughly USD 5 Billion by 2024, with an estimated compound annual growth rate (CAGR) of 9.5% (Market Research Future, 2021). The popularity of VCO has been rising steadily both in the coconut producing regions and in developed regions, such as North America, Europe, and Northeast Asia.

VCO is obtained from the fresh kernel of the mature coconut by mechanical or natural means, without the use of chemical processing, such as refining, bleaching, or deodorizing (APCC 2009).

There are three main ways of making VCO: fermentation, centrifuge, and expeller methods. While there are subtle organoleptic differences among them, the major chemical parameters of the VCO produced from them are the same.

Unique attributes of VCO

VCO is a vegetable oil that has a fatty acid composition that is about 63% medium chain-saturated fatty acids (C6:0 to C12:0), 29% long-chain fatty acids (C14:0 to C18:0), and 8% unsaturated fatty acids.

The fatty acid composition of VCO is distinct from the commonly consumed vegetable oils and animal fats, which are composed mainly of long chain fatty acids and which have considerable unsaturation. VCO is also unique in that it is water white, while other vegetable oils are yellowish.

Adulteration of VCO with RBDCO

Because of the very different fatty acid composition of VCO from other vegetable oils, it is relatively easy to detect adulteration with these oils using analysis of fatty acid methyl esters with gas chromatography.

Because refined, bleached and deodorized coconut oil (RBDCO) has the same fatty acid profile as VCO and is much cheaper, it is the most common adulterant of VCO. Although the RBDCO is usually yellowish, RBDCO can be made almost colorless with further bleaching. Numerous companies now sell "pure white coconut oil" for cooking or cosmetic use. The standard method of the Lovibond color measurement is unable to detect such adulteration.

Detection of adulteration of VCO with RBDCO

The main challenge is the detection of VCO adulteration with RBDCO. We studied three methods – UV-visible (UV-vis) spectroscopy, Fourier-transform infrared spectroscopy (FT-IR), and nuclear magnetic resonance (NMR)

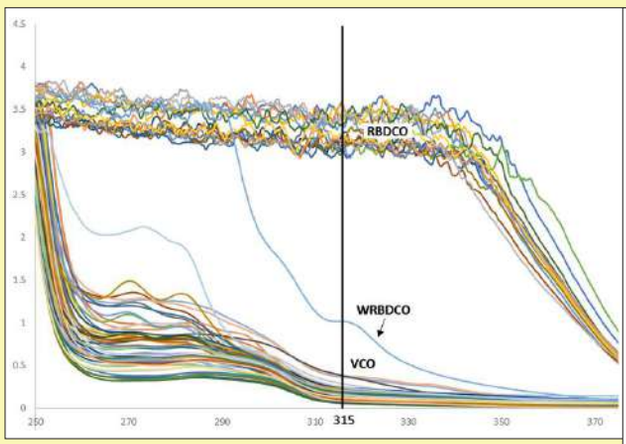

Figure 1. Overlay of UV-visible spectra of VCO, RBDCO and white RBDCO samples. This method can differentiate VCO from RBDCO and white RBDCO at 315 nanometers wavelength.

spectroscopy – to differentiate VCO from RBDCO and to detect adulteration of VCO with RBDCO.

UV-visible spectroscopic measurement at 315 nanometers

Light at a wavelength of 315 nanometers is able to distinguish VCO from RBDCO sufficiently well. Figure 1 shows that the signal of VCO at this wavelength does not exceed 0.8 absorbance units (AU), while white RBDCO has a signal above 1.2 AU. The absorbance of RBDCO is even higher than this. This is a low-cost method of differentiating VCO from RBDCO, and for detecting adulteration.

Fourier transform-infrared spectroscopy (FT-IR)

FT-IR has been used to detect adulteration of different types of coconut oil with different adulterants. In an early study on VCO adulteration, Manaf and co-workers (2007) showed that the use of FT-IR equipped with multibounce attenuated total reflectance ATR) attachment was able to detect adulteration of VCO with palm kernel olein (PKO), down to adulteration of as low as 1%. Che Man and Rohan (2013) used FT-IR to detect adulteration of VCO with canola oil, a high-oleic acid oil. Amit and co-workers published two studies (2020a, 2020b) which used FT-IR to detect adulteration of fresh RBDCO with used fried coconut oil, and in another study the adulteration of VCO with paraffin oil, while Neves and co-workers (2020) also used FT-IR to detect adulteration of VCO with polyunsaturated vegetable oils namely, canola, corn, sunflower and soybean.

Our attempt to differentiate VCO from RBDCO using FT-IR without ATR was not successful. Figure 2 shows

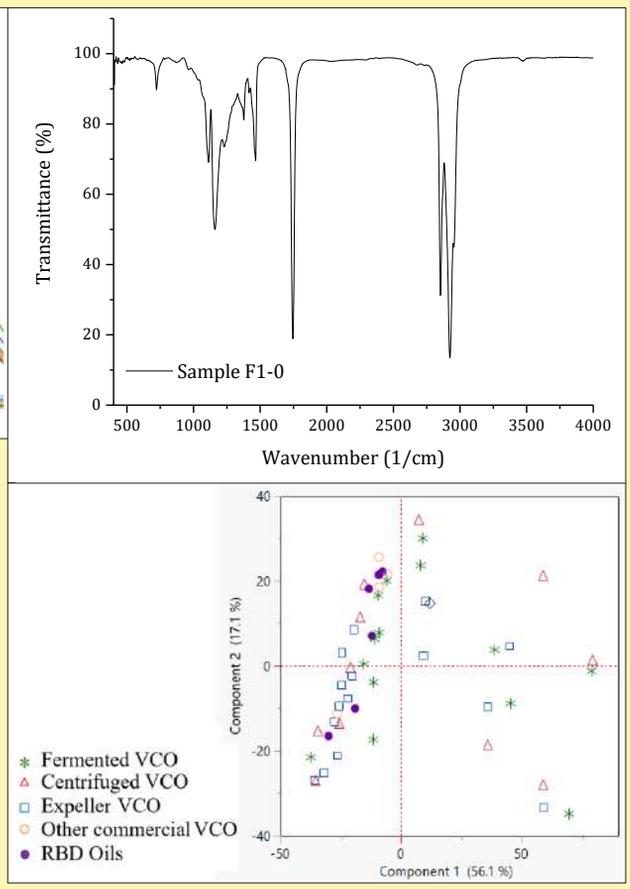

Figure 2. a. FT-IR spectrum of a VCO sample; b. Principal components analysis (PCA) of FT-IR spectra of various VCO and RBDCO samples. FT-IR is unable to separate VCO from RBDCO samples.

a FT-IR spectrum of VCO and the principal components analysis (PCA) of VCO and RBDCO samples. The grouping of the RBDCO samples suggested higher similarity of IR bands compared with VCO samples which were more dispersed. It appears that enhancement of signals using ATR may be needed to detect adulteration of VCO with similar oils, such as RBDCO and PKO.

13C Nuclear Magnetic Resonance (NMR) spectrometry

Different fats and oils are made up of characteristic mixtures of mono-, di- and triglycerides with their respective component fatty acids. Proton (1H) and carbon (13C) nuclear magnetic resonance (NMR) spectroscopy have been extensively used for the profiling and detection of adulteration of various fats and oils, in particular virgin olive oil (VOO), because of its high economic value (Dais and Hatzakis, 2013). In this regard, NMR, in conjunction with statistical techniques, has been successfully used to authenticate VOO, taking advantage of signals due to presence of the double bonds.

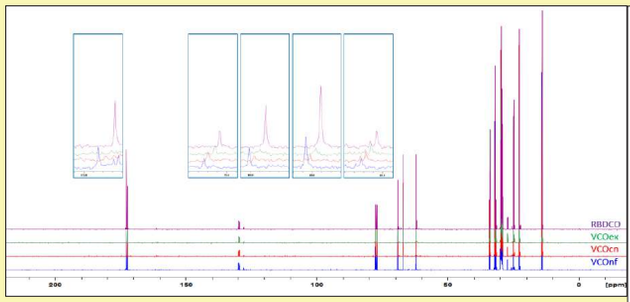

Figure 3. ^{13}C nuclear magnetic resonance (NMR) spectra of RBDCO, expeller VCO, centrifuge VCO and fermentation VCO.

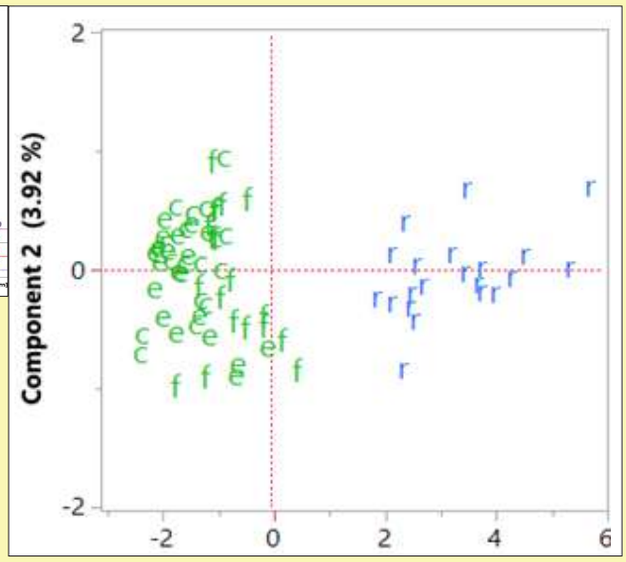

Figure 4. Principal components analysis (PCA) of VCO and RBDCO samples shows that the three types of VCO (centrifuge (c), expeller (e), and fermentation (f)) are clearly separated from RBDCO (r).

The situation is more challenging for VCO because of its highly saturated composition. It turns out that although VCO and RBDCO have the same fatty acid compositions, their glyceride compositions differ. In this way, NMR can be used to differentiate VCO from RBDCO and to detect adulteration.

Figure 3 shows the 13C NMR signals of VCO and RBDCO samples while Figure 4 shows the PCA that is able to clearly separate VCO and RBDCO samples. Analysis of 2-year old VCO also shows that these can be differentiated from fresh VCO samples. Work is on-going to apply this method to the differentiation of VCO which is made using different processes.

Future challenges

VCO is a very versatile vegetable oil and it is used in many products, both food and non-food products. As it gets used together with other materials, the challenge of detection of adulteration will arise. Research must continue to develop methods that can detect adulteration in parallel with the development of new products.

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COCONUT FARMING IN THE ARABIAN SEA
MAAFAHI ISLAND, MALDIVES

Lalith Perera[1]

Aerial view of Maafahi Island

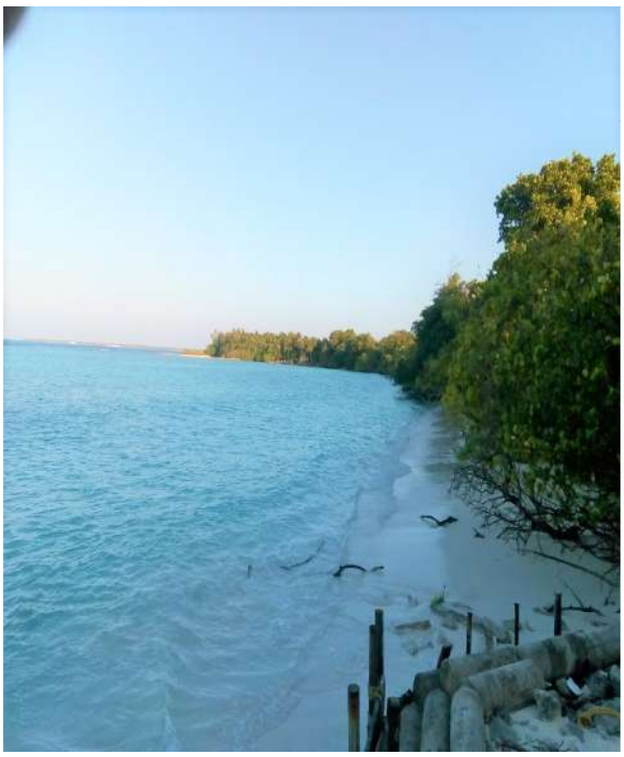
Coconut Planting in the island

The Republic of Maldives is a country in South Asia, located in the Arabian Sea of the Indian Ocean. It lies southwest of Sri Lanka and India, about 1,000 km from the Asian continent. The chain of 26 atolls stretches from Ihavandhippolhu Atoll in the north to Addu Atoll in the south. Comprising a territory spanning roughly 298 square km, the Maldives is one of the world's most geographically dispersed sovereign states as well as the smallest Asian country by land area and population.

The Maldives has a tropical monsoon climate which is affected by the large landmass of South Asia to the north. Because the Maldives has the lowest elevation of any country in the world, the temperature is constantly hot and often humid. Two seasons dominate Maldives' weather: the dry season associated with the winter northeastern monsoon and the rainy season which brings strong winds and storms.

The Maldives has twenty-six natural atolls and few island groups on isolated reefs, all of which have been divided into twenty-one administrative divisions (19 administrative atolls and cities of Malé and Addu). Coconut has a historical significance in Maldives and is the national tree of Maldives. Among the diverse vegetation of Islands of Maldives, coconut covers about 75%.

The Mafaahi Island is located in the Mathi-Uthuru Province in the Haa Dhaalu Atoll, near the



Side view of the island

Entrance to the Maafahi island, along the Jetty

Hanimaadhoo Island, one of the inhabited islands of Haa Dhaalu Atoll. A fascinating well planned agriculture project is being carried out in this Island on a substantial scale. This project is run by Seagull Maldives which is one of the Maldives' few private farming and fishing operations. The produce of this island is mainly used to stock their cafe and supermarket in the capital Malé and the surplus is supplied to the resorts in suburb islands. In the Mafaahi Island, coconut as well as varieties of fruits and vegetables, mainly papaya and banana, are cultivated in large sale with goat farming integration. The extent of the island is about 90.6 ha (270ac) and out of which about one third of is developed into an agriculture project and the rest is covered with the natural forest.

I have along with two of my agricultural experts carried out a sincere visit to observe the coconut plantation in the Maafahi Island.

Coconut growing soils in the Mafaahi Island is consisted of weathered and un-weathered corral materials found underneath the ground and white sand. Coral rocks are the soil parent materials forming white sandy soils. Decaying coral particles in different sizes were observed within the soil profile. The water-holding capacity of the soil is very poor due to high porosity and infiltration rates. Coral deposits were found in deep layers. When the profile of soil is considered, clear layers of sediment soils cannot be identified. However, soil profile has no disturbance for root growth of coconut and other crops. The soil appeared poor in plant nutrients. From the color of top and sub soils, it appears that the organic matter content of the soil too is very low. Hence the retention of soil nutrient in this soil is poor. It was also observed that the ground water level of the island is shallow and the water level fluctuates mainly within 3 - 5 feet level with high and low tides. As coconut roots could penetrate the soil easily and root system of coconut has established well, with the fully distributed root system, soil provides better anchorage even to tall coconut palms. Considering these soil characters, this soil could be categorized as marginally to moderately suitable for coconut cultivation. Coconut roots could easily reach the ground water level and absorb the required water. The hard conditions of ground water and high EC levels and 7.8 PH are within the tolerable levels for coconut (hard water is formed when water percolates through deposits of limestone and chalk which are largely made up of calcium and magnesium carbonates). The hard condition of ground water may not be tolerable for some fruits and vegetables.

Climate conditions

In the Mafaahi Island the temperate in March to April was said to be between 32°C – 35°C in daytime which may affect the pollination and the viability of pollen. This can seriously affect the nut setting thereby reducing the yield. It takes about 12 months from nut setting to mature a nut; hence effect of pollination can be seen only after a year.

The Maafahi Island receives rains mainly in two monsoons in May – July and September – November in each year. During these periods the Island receives sufficient rains. Periods in between two monsoons

Beverage varieties: Red dwarfs and Yellow dwarfs brought from Sri Lanka

Native coconut palm bearing large bunches with very small nuts

are dry months which may be prolonged due to delays in monsoonal rains in the island. January to end April is severe drought with high heat stress in the Island.

Coconut plantations

In agricultural projects, the main vegetation is coconut, which is planted in two main blocks and along either side of the roads. One coconut block is planted in 1998 (Block 01) with 460 palms at the age of about 18 years and the other block (Block 02) is planted in 1999 and 2000 with 1050 palms of 19-20 years of age. Both these plantations are in bearing stage. These two blocks are basically planted with a selected tall coconut variety brought from Addu atoll, which is said have been bearing large fruits compared to low yielding native coconut variety in Mafaahi island. Some native coconut trees are still present near the beach and at the edge of the agriculture project area and some among coconut trees in the main coconut blocks. The specific characters of native coconut are the presence of many female flowers in the inflorescence, large bunches with very small nuts in different sizes.

Most mature small nuts look to have no economic value for consumption and value addition. However, it has been observed that native coconut has not been used as seed nuts for the second-generation planting of coconut in the island. In addition to this main variety, king coconut, green dwarf, yellow dwarf and red dwarf coconut brought from Sri Lanka are seen mainly planted along either the sides of roads. All these palms are now in good health and are in well bearing stage. Immature nuts from these color forms are harvested frequently for beverage purpose. In addition, a few blocks of healthy and vigorously grown coconut seedlings were also observed.

The Block No. 01 and Block No. 02 although have shown vigorous and healthy growth, the nut production of each palm appears to be very low. All these palms have been planted at a close distance of about 20'x 20' square systems with a density of over 100 palms per acre than the recommended distance for coconut.

Acknowledgement

Our team wishes to acknowledge Mr. Salah Shihab, Managing Director of the Seagull Pvt. Ltd, Maldives for the opportunity given to visit the Mafaahi agriculture project. We also very sincerely thank Mr. Marlan Jayathilake, The Marketing Manager of Seagull Pvt. Ltd, for his excellent organizing of this sincerely visit. We also wish to express our sincere gratitude to Mr. Indran, Assistant Manager and Mr. Ali Shifaz, Project Manager for their friendly cooperation extended to us during our visit to Mafaahi Island.

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HALF A TRUTH IS OFTEN A GREAT LIE: ON COCONUT OIL AND HEART DISEASE

Fabian M. Dayrit*

"Half a truth is often a great lie."
– Benjamin Franklin, *Poor Richard's Almanack* 1758

On January 4, 2021, the *New York Times* published an article entitled "Does Coconut Oil Deserve Its Health Halo?"[1], which challenged the health properties of coconut oil and the claims that it is a "miracle food."

While it is wrong to tout coconut oil as a "miracle food", it is equally wrong to criticize it based on half-truths.

This article presents the other half of the truth on three issues that were brought up in the article: LDL cholesterol, lauric acid, and the coconut diet.

Half-truth #1: Coconut oil raises "artery-damaging" LDL cholesterol

There are several half-truths with this statement. While coconut oil tends to raise LDL cholesterol, not all LDL cholesterol is "artery damaging." Recent evidence has shown that "LDL cholesterol" is really made up of particles of many sizes, and coconut oil increases the larger LDL particles, which are not strongly linked to heart disease.[2] So, this accusation against coconut oil is not supported by the latest scientific evidence.

An equally important blood parameter that the article ignored is HDL cholesterol, the so-called "good cholesterol". It is well known that coconut oil raises HDL cholesterol[3] and a high HDL cholesterol level is linked to a lower risk for heart disease.

In addition, the article also failed to mention that coconut oil lowers the levels of triglycerides and HbA1c in the blood. A low triglyceride level protects against heart disease and a lower HbA1c is indicates lower risk for diabetes.[4]

Why did the article ignore the beneficial effects of coconut oil on the raising of HDL cholesterol and the lowering of both triglycerides and HbA1c?

Half-truth #2: Lauric acid closely mimics the effects of tallow and butter

It is not right to compare a single fatty acid – lauric acid – with whole fat products. The proper comparison should have been between coconut oil versus tallow and butter.

A simple check with the USDA FoodData Central website[5] shows that coconut oil contains about 41g of lauric acid per 100g of oil, while tallow contains a mere 0.9g and butter contains only 2.6g.

Another fact that was ignored is that coconut oil contains zero to negligible amounts of cholesterol, while tallow and butter contain high amounts of cholesterol.

The article then denied the fact that lauric acid is a medium-chain fatty acid. Unlike the long-chain fatty acids, lauric acid is able to rapidly enter the mitochondria, the energy system of cells, to be converted to energy; lauric acid does not require carnitine to cross the mitochondrial membrane unlike long-chain fatty acids.[6]

Consistent with this, lauric acid is not deposited in fat tissues in the body and does not make one fat.

Lauric acid is the fatty acid with the highest antibacterial and antiviral activities.[7] Indeed, coconut oil can be considered a functional food because of its antimicrobial properties.

Thus, there is no basis for saying that coconut oil and tallow and butter have the same health effects.

Half-truth #3: The healthy tropical diet can be dissociated from coconut oil

The article acknowledged that the traditional Pacific islanders "consume rather large amounts of coconut products without suffering high rates of cardiovascular disease," but attributed this to the fruits, vegetables and seafoods that they consume, as well as their active lifestyle – everything except coconut oil.

Ignoring the role of coconut oil is hard to accept if one realizes that in the traditional Pacific island diet, coconut accounted for 34% to over 60% of total calories. Since coconut oil makes up about 35% of coconut meat, these islanders would have been consuming 10% to over 20% of their calories as coconut oil, with no link to heart disease.[8]

In 2003, WHO reported that the Pacific islanders became obese and diabetic when they switched from their traditional diet, which included coconut oil, to a western diet, including its fats and oils.[9]

Dissociating coconut oil from the tropical diet is like dissociating olive oil from the Mediterranean diet. The beneficial role of coconut oil in the tropical diet cannot be denied by half-truths.

Half-truths for 60 years

Dr. Frank Sacks, former chair of the American Heart Association, was quoted as saying: "I could find nothing in the scientific literature to support advertising claims that coconut oil has some beneficial effects."

This is truly surprising because PubMed.gov contains over 2,500 entries on "coconut oil," and the number of articles published on this topic has been trending upwards quite significantly over the past 10 years.[10]

Dr. Sacks also lamented a recent survey that showed that 72% of Americans believe that coconut oil is healthy, ignoring the AHA's expert advice.[11]

What is surprising is that even after 60 years of half-truths, 72% of Americans believe in the health benefits of coconut oil.

Indeed, behind all of these half-truths about coconut oil is a great lie.

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MANAGEMENT OF *VERNONIA ZEYLANICA* (L.) PLANT POPULATION WITH DIFFERENT WEEDING PRACTICES IN COCONUT PLANTATIONS OF SRI LANKA

S. H. S. Senarathne[1], I. M. P. S. Ilangamudali[1] & S. S. Udumann[1]

Vernonia zeylanica (L.) which belongs to the family Asteraceae, is a dominant weed species in coconut plantations in Sri Lanka. This study reports the results of a field trial conducted to determine the effects of selected weeding practices on plant population changes and seedling emergence patterns of *V. zeylanica* in coconut plantations in Sri Lanka. Treatments imposed were application of glyphosate (T1), cover cropping with *Pueraria phaseoloides* (T2), tractor harrowing (T3) and tractor slashing (T4). All treatments were applied twice a year except for the (T2). Based on the results of reduction in biomass, the *V. zeylanica* biomass, application of glyphosate (T1) and cover cropping (T2) practices were very efficient to reduce the *V. zeylanica* population. Chemical weeding and cover cropping were the best methods to reduce seedling emergence density in the field. The effectiveness of slashing and harrowing practices in reducing *V. zeylanica* seedling emergence density was lower than cover cropping and chemical weeding treatments. The seedling emergence densities were almost similar in slashed and harrowed plots. The seedling emergence depth of *V. zeylanica* was very high in the harrowed treatment when compared to other treatments. This indicated that loosening the soil creates more favorable environment for the germination of *V. zeylanica* seeds buried in soil. This therefore suggests that the elimination of *V. zeylanica* seeds in the top 2- 4 cm depth in the soil seed bank by any means is likely to reduce the level of weed infestation by about 60% to 95%.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is by far the most extensively cultivated plantation crop in Sri Lanka. It is essentially a small holder crop comprising about 86% of small holdings and homesteads and the balance belonging to the estate sector.

Vernonia zeylanica (from Trees.lk)

The growth habit and canopy structure of the coconut palm requires a wide spacing between palms, which permits abundant sunlight to the ground vegetation. Thus, a wide range of perennial and annual weed species invade unutilized space beneath the plantation (Senarathne and Sangakkara, 2009). Such weeds invariably compete with coconut palms for soil moisture and nutrients, affecting growth and yield and obstructing routine management practices (Senarathne and Sangakkara, 2009). The density, vigour, type of weeds and their distribution mainly depend on the age of plantation, agroecological zone and size of holding. Generally, the microclimate of the understory in young coconut stands is more favorable for rapid growth of noxious weed species than in mature plantations. Further, weed competition appears to be more serious in the Dry Zone than in the Wet Zone (Senarathne *et al*., 2003).

V. zeylanica (L) is an herbaceous, perennial, broad leaved, erect, strongly aromatic and deep rooted herb belonging to the family Asteraceae, and is one of the major endemic weed species present in coconut plantations in Sri Lanka. It competes for soil moisture, nutrients and light especially when coconut palms are at the seedling stage. Jayaweera (1982) stated that it is anunder shrub with many straggling, divaricated cylindrical branches finely tomentone when young. Therefore, it grows vigorously by covering the ground of coconut plantations under both moist and dry conditions. Additionally, it interferes and inconveniences the estate management practices such as manuring, harvesting and collection of nuts. Initially, this weed species is propagated by seeds and stem cuttings and re-grows after slashing. Therefore, there is an acute need to introduce effective and economically viable weed control strategies to manage this weed for coconut growers in Sri Lanka.

In integrated weed management, all available strategies are used in order to reduce weed seeds in the soil, to prevent weed emergence from the seed bank and to minimize competition from weeds in agricultural soils (Vasileiadis *et al*., 2007; Barberi *et al*., 1998 and Campiglia *et al*., 2015). This implies that any successful long term weed management programme should be aimed at controlling the emergence of seedlings from the soil. Further, unpredictable emergence of weed seedlings from dormant seeds makes weed management a more difficult and costly operation in arable lands (Carves and Benoit, 1989). Therefore, manipulation of environmental conditions to reduce emergence of undesirable species in the established crop or at least to optimize the establishment of desirable species is an effective and economical strategy for weed management. In order to develop a sustainable integrated weed management strategy, a detailed understanding of the seed bank is required, incorporating germination characteristics of weed seeds and factors that regulate emergence and establishment of seedlings in the field. Although there are many studies on weed biology, weed competition and herbicide technology, little attention has been paid to investigate the regulation of weed seedling emergence in coconut lands, which is the focus of this study. Therefore, the objective of this study was to evaluate the effect of different practices for management of *V. zeylanica* on the seedling emerging pattern and emerged seedling population under field conditions.

MATERIALS AND METHODS

This experiment was carried out at the Seram Estate, Iriyagolla, in the Lower country Intermediate Zone of North Western province of Sri Lanka from June 2013 to December 2015. The area is characterized by bi-modal pattern of rainfall with an annual mean precipitation of more than 1100 mm. Approximately 65% of the annual rainfall is received from September to December (Maha rain season). The soil at the site is a predominantly well-drained Red Yellow Podzolic (RYP) soil with soft or hard laterite (70-90%) (De Alwis and Panabokke, 1972). Surface soil is brown in colour with a sandy loam texture. Structure development is moderate due to presence of sand in the surface soil. Sub surface soil is dark to yellowish brown in colour with prominent mottles. Texture of the subsoil is sandy loam to sandy clay loam. Reaction of the soil is strongly acidic (pH 5.0 – 5.5). Base saturation of the subsurface soil is greater than 35%. Organic carbon content in the surface soil is generally less than 1% under natural conditions (Mapa *et al*., 2005). The experimental design was a Randomized Complete Block design with three replicates and plot size was four coconut squares (the spacing of the square planting system of coconut is 8.2 m x 8.2 m).

Treatments

Five different treatments were evaluated.

T_1 Chemical weeding (Application of Glyphosate 1.44 kg a.i. per hectare)

T_2 Establishment of cover crop (*Pueraria phaseoloides*)

T_3 Tractor harrowing (once in six month) (0 cm - 15 cm depth)

T_4 Tractor slashing (once in six month)

T_5 Un-weeded (Control)

The four different weed management systems were applied to control *V. zeylanica* according to the schedule. In the chemically controlled plots glyphosate (1.44 ai kg /ha) was applied (Senarathne *et al*., 2003) at 6 month intervals, at the latter part of the rainy season using a knapsack sprayer in the morning. Generally, there was no rain for five to six hours after applying glyphosate.

Puereria phasioloides which is one of the cover crops recommended for Coconut Plantations (Coconut Research Institute, 2012) was established to control *V. zeylanica* and the over grown conditions of cover crop was managed to overcome competition by harrowing once a year. Tractor

Pueraria phaseoloides (from replantcoconut.blogspot.com)

harrowing and slashing were done at the latter part of the rain season at six month intervals.

Data collection

Weed biomass: The *V. zeylanica* biomass within 1 m x 1 m quadrant was collected from four random points per plot. Plant samples were dried at 80°C for five days and weighed. The dry weight of *V. zeylanica* was measured separately for every two months from June 2013 to December 2015.

Emergence of Vernonia zeylanica seedlings in the field: Four permanent quadrants (1 m x 1 m) were fixed randomly in each plot to monitor emergence of *V. zeylanica* seedlings. The emerging seedling count was taken before and after applying all treatments. The weeds which emerged around a 30 cm border area outside each quadrant were removed frequently while the remaining area had free weed growth. The emerged *V. zeylanica* seedlings within each quadrant were identified, counted and removed weekly for 12 weeks after applying the treatments. Estimation of average seedling density was obtained by summing the seedling count over the experimental period from June 2013 to December 2015.

The seed depth of emerging weed seedlings in the field: This study was done in 2013 Yala rain season (April-June), 2013 Maha rain season (September-October), 2014 Yala rain season (April-June), 2014 Maha rain season (September – October), 2015 Yala rain season (May-June) and 2015 Maha rain season (September-October). The germination and emergence of *V. zeylanica* seeds at different depths in the soil were measured in the field. The study used 30 *V. zeylanica* seedlings. The seedlings were marked at ground level with Indian ink and each seedling was excavated to the depth of its caryopsis and the length for the caryopsis to the ink mark of each seedling was measured as described by Witharama (1998). Estimation of average seedling emergence depth was calculated by measuring the seedling emergence depth over the four rain seasons.

Data analysis

Data were analysed statistically by the Procedure of Analysis of Variance and means were separated using the Least Significant Difference test at the 0.05 significance level. Statistical program was the Statistical Analysis System (SAS 1999).

RESULTS AND DISCUSSION

Effect of different agronomic practices on *V. zeylanica* biomass

The lowest *V. zeylanica* biomass was recorded in chemical weeding plots where glyphosate was applied (T1) at a concentration of 1.44 kg a.i. /ha and in plots with *Pueraria phaseoloides* cover crop (T2) (Figures 1). When glyphosate was applied, the *V. zeylanica* biomass was reduced and weed seeds in the soil seed bank initiated germination with onset of rainy season.

Initially *P. phaseoloides* took several months to establish a good ground cover. The biomass of *V. zeylanica* was very high at the initial stages in cover cropped plots which gradually declined after December 2013. *Pueraria* regenerated seeds with time and formed a good ground cover, thereby suppressing ground weed populations (Figure 1). However, with time, cover crop management was essential to avoid possible competition between coconut palms and cover crops which suppressed the growth of *V. zeylanica* and other weed species. The two mechanical weeding treatments, tractor harrowing (T3) and tractor slashing (T4) suppressed *V. zeylanica* growth initially, but rapid re-growth was observed in the *V. zeylanica* plants during the experimental period when compared to the other dicotyledonous weeds. Generally slashing

damaged the aerial parts of the weeds but with no damage to the root system or underground plant parts such as stolons and rhizomes of the grass weed species. During favorable weather conditions, underground plant parts produced new shoots or new flushes. For example, the monocotyledonous weeds *Imperata cylindrica*, *Panicum maximum* and *Cynodon dactylon* and several dicotyledonous weeds *Lantana camara* and *Chromolaena odorata* produced a new flush within a few weeks of slashing.

Tractor harrowing at six-month intervals reduced the weed biomass significantly when compared to slashing. Harrowing facilitated burial of weed seeds in deep layers, and thus reduced the growth of weed population on the surface. However, this practice loosens the soil and would create a suitable environment for the germination of the seeds of other weed species (Senarathne and Sangakkara, 2009).

V. zeylanica seedling emergence density in the field

The numbers of *V. zeylanica* seedlings emergence gradually decreased with time in T1 and T2 treatments. However, in the control (T5), harrowing (T3) and slashing plots (T4) higher *V. zeylanica* seedling density was observed on the surface (Figure 2).

The seedling emergence density was significantly lower ($P<0.05$) in chemical (T1) and cover cropping (T2) treatments compared to other treatments. The densities of emerged *V. zeylanica* seedling were almost similar in the chemically treated and cover cropped plots. The use of herbicides can also influence the species composition of the seed bank and seedling emergence density depending on the chemicals used (Ball, 1992). Soil weed seed and seedling emergence densities can also influence the effectiveness of pre-emergence and post-emergence weed control tactics (Winkle *et al*., 1981 and Sparks *et al*., 2003). It has been shown that the interaction between initial weed seedling density, post-emergence herbicide, and mechanical weed control provides a positive linear relationship between initial seedling density and density of surviving seedlings (Dieleman *et al*., 1999). Furthermore, the development of effective management strategies that reduce weed fecundity, will be aided by species-level information that identify tactics most appropriate for a given weed spectrum. Research has demonstrated that herbicides applied at early flower or pod set can reduce potential seed-bank replenishment (Bennett and Shaw, 2000; Walker and Oliver, 2008). Additionally, seed weight reduction, seed viability, and seedling recruitment can affect the presence of plant species in the following season (Jha and Norsworthy, 2012). The *V. zeylanica* seedling

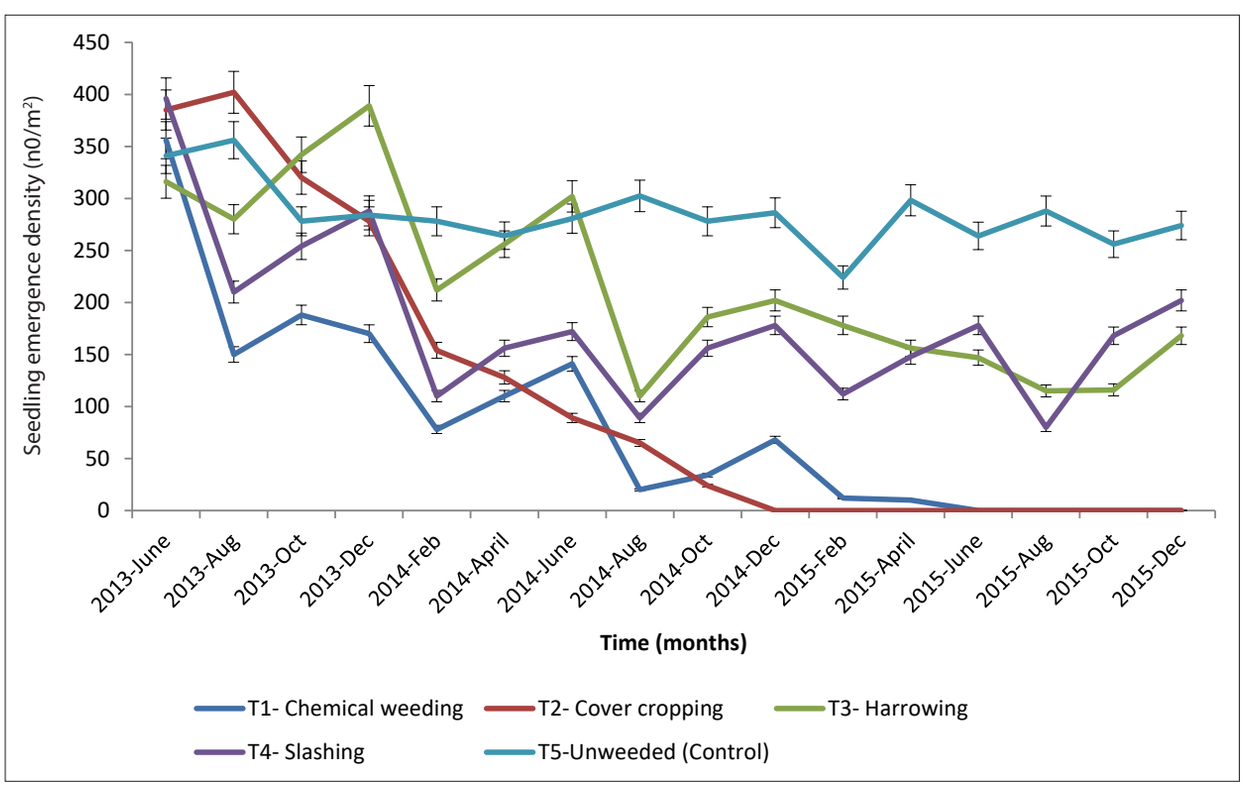

Figure 1. Effect of different agronomic practices on total biomass of V. zeylanica *from June 2013 to December 2015. Vertical bars indicate + SE of the mean, Treatments were applied in July 2013, January 2014, July 2014, January 2015 and June 2015.*

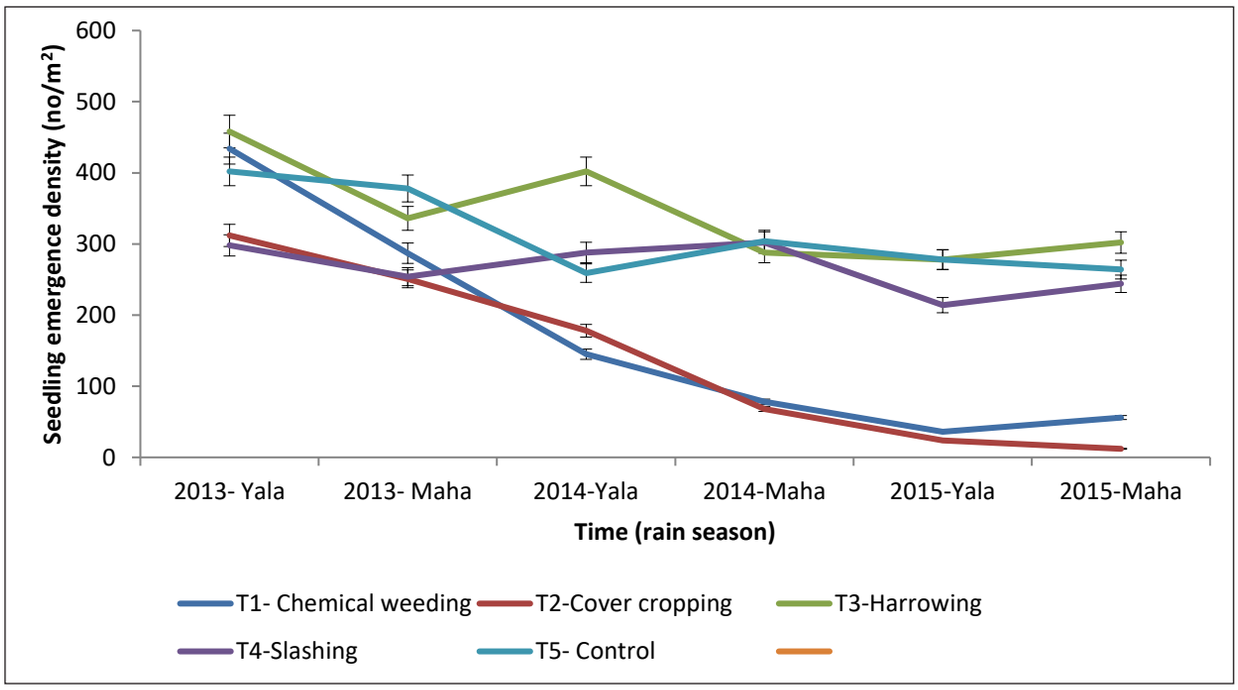

Figure 1. Effect of different weeding treatments on average V. zeylanica *seedling emergence density from 2013 to 2015. Vertical bars indicate + SE of the mean, Treatments were applied in July 2013, January 2014, July 2014, January 2015 and June 2015.*

emergence densities were almost similar in slashed (T5) and harrowed plots (T3) (Figure 2). Some weed species invaded a higher intensity of emergence in the no tillage planting than in the conventional tillage. The presence of seeds at the superficial layer of the soil and frequent cultivation, are factors that reduce the seed bank rapidly. This situation can facilitate seed loss by exposing seeds to variations in temperature and humidity, and breaking dormancy and finally reducing the seedling density in the field (Simpson *et al*., 1989). In the present study, chemical weeding and cover cropping were the best methods to reduce weed seedling emergence density. This may depend on several factors, including the pattern of rain fall, time of germination at the site, the timing of seed input (seed rain) into the seed bank, different agronomic practices (Coffin and Lavenroth, 1989) and seed and seed losses due to predators (Hodgkinson *et al*., 1980; Rice 1989). However, different weeding methods over the experimental period in different treatment plots produced dense stands of weeds and the seed from these plants probably caused the seed bank changes observed in subsequent sampling occasions.

The seed depth of emerged *V. zeylanica* seedlings in the field

The average depths of *V. zeylanica* seedlings emergence in the field are presented in Table 1. The seed depth of emerged seedlings of *V. zeylanica* was very high in harrow weeding treatment when compared to other weeding treatments.

A total of seventy two percent (72%) of the *V. zeylanica* seedlings emerged to the surface from 2 cm soil depth while 28% emerged at 2-4 cm soil level indicating that more small seeds germinate in top soil layers. The highest recorded depth from which *V. zeylanica* seedlings emerged was 3.32 cm in harrowed plots.

This indicates that loosening the soil creates more favorable environment for germinating of weed seeds buried in soil layers. Therefore, it can be argued that the elimination of weed seeds in the top 2 cm or 4 cm in the soil seed bank by any means is likely to reduce the level of weed infestation by 60% and 95% respectively. The largest quantities of seeds are typically found in the top 10 cm of the soil profile (Cardina *et al*., 2002; Clements *et al*., 1996 and Swanton *et al*., 2000). Typically, the extent and depth of seed distribution in the soil profile is directly related to the amount of soil disturbance (Dyer, 1995), which can be influenced by the type of cultivation implement and tillage system (Cardina *et al*., 2002 and Clements *et al*., 1996). However, this is not always the case (Zanin *et al*., 1997). Furthermore, small seeds are more likely to become buried than large weed seeds. Whether buried seeds contribute to soil seed-bank persistence and weed population regeneration depends on the depth from which the seeds can germinate (Baker, 1989).The importance of soil tillage has been mentioned as a primary tool for the depletion of seed-bank persistence. However, accumulation of seeds on soil surface in reduced-tillage cropping systems

Species / treatments	Depths of emergence (cm)				Means emerged depth (mm)
	0-2 cm	2-4 cm	4-6 cm	6-8 cm	
T_1 Chemical weeding	35	5	-	-	05.95[c]
T_2 Cover cropping	11	16	-	-	17.23[b]
T_3 Harrowing	28	22	-	-	21.13[a]
T_4 Slashing	32	6	-	-	12.01[b]
T_5 Control	33	4	-	-	03.79[c]
Total	**139 (72%)**	**53 (28%)**	**-**	**-**	

* Values followed by the same letters are not different at P<0.05 in each treatment

Table 1. The average number of V. zeylanica *seedlings which emerged at different soil depths in different weeding treatments*

could increase seed mortality due to increased seed predation (Hossain and Begum, 2016). Intensive soil cultivation, such as moldboard plowing, that turns the soil up to 20 cm, has a more uniform distribution of seed in the soil profile. Lack of soil disturbance via tillage could also encourage higher predator populations, as it enhances the number, diversity, and/or activity of seed-consumption (Blubaugh and Kaplan, 2015; Landis *et al*., 2005).

CONCLUSION

Application of glyphosate (1.44 kg a.i./ha) and cover cropping (*P. phaseoloides*) are very effective methods in reducing *V. zeylanica* biomass and weed seedling emergence density when compared to other mechanical weeding methods such as harrowing and slashing. Mechanical weeding is a labor intensive method to manage weeds in coconut plantations. However, an integrated approach such as the application of glyphosate followed by establishment of leguminous creeping cover crops is very effective in controlling *V. zeylanica*. Considering the soil seed bank, the results of this study have provided useful information on timing, emergence density and composition of *V. zeylanica* population that are likely to emerge under different types of agronomic practices in relation to the seed bank. However, the depth of weed seedling emergence was very high in harrowing treatment plots when compared to the other weeding methods. This indicated that loosening the soil creates a more favorable environment for germination of weed seeds buried in deep soil layers.

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COCONUT
IN DAIRY INDUSTRY

Shameena Beegum, P. P.[1], Manikantan, M. R.[1], Pandiselvam, R.[1] & Hebbar, K. B.[1]

Value addition is the imperative alternative to improve the farmer's income and livelihood security. Incorporation of coconut products in ice cream and other frozen desserts is being practiced in countries like Thailand, Malaysia and Indonesia. In India, coconut pulp is added to ice cream to convert it into a premium product and sold as tender coconut ice cream by several brands.

There always exists a good and prospective market for dairy based products such as ice cream, kulfi, yogurt, milk shakes etc. Coconut milk can be the best substitute for dairy milk especially for those in the Asian countries where coconut is abundantly available and is an integral part of the daily diet.

An increased demand for non-dairy probiotic products also have come mainly from lactose intolerance, vegetarianism and milk cholesterol content. Present scenario of price fluctuation in coconut has put the coconut farmers in agony. Value addition is the imperative alternative to improve the farmer's income and livelihood security. Incorporation of coconut products in ice cream and other frozen desserts is being practiced in countries like Thailand, Malaysia and Indonesia. In India, coconut pulp is added to ice cream to convert it into a premium product and sold as tender coconut ice cream by several brands including Naturals, Meriiboy, Lazza etc.

According to FSSAI, ice cream means frozen milk product obtained by freezing a pasteurised mix prepared from milk or other products derived from milk, or both, with or without the addition of nutritive sweeteners and other permitted non-dairy ingredients. The said product may contain incorporated air and shall be frozen hard, except in case of softy ice cream, where it can be frozen to a soft consistency. Frozen desserts or frozen confections mean the products obtained by freezing a pasteurised mix prepared with edible vegetable oils or fats or vegetable protein products, or both. It may also contain milk fat and other milk solids with the addition of nutritive sweeteners and other permitted non-dairy ingredients. Similar to ice cream, the said product may contain incorporated air and may be frozen hard or frozen to a soft consistency. The only difference between frozen dessert and ice cream is that frozen desserts use vegetable fat in place of milk fat.

The constituents of an ice cream are milk fat, milk-solids -non fat, sugar, stabilizers, emulsifiers, flavor and colour. Milk fat enriches and mellows the ice cream, it adds to the sweet taste. The protein helps to make the ice cream more compact and smooth. Sugar is added to increase the acceptability of the product. It is the cheapest source of total solids in the mix. Stabilizers are added to prevent the formation of large ice crystals during storage. Emulsifiers provide uniform whipping quality to mix and also to produce ice cream with smoother body and texture. We have tried to substitute the major source of fat and solids non fat (SNF) in ice cream ie. cream and skimmed milk powder with coconut milk and tender coconut pulp respectively. The first step for making ice cream is the selection and preparation of ice cream mix. Knowledge of calculation of ice cream mix is helpful for properly balancing a mix, in establishing and maintaining a uniform quality and in making a product that conforms to legal standards. Before making the mix, proximate composition of the major ingredients should be estimated and accordingly ice cream mix can be made with the addition of water for making upto hundred percentage. Tender coconut water obtained after the extraction of pulp was added in place of potable water used for dilution.

Refined sugar was replaced with coconut sugar which is a good source of vitamins, amino acids, minerals besides calories. Dairy milk contains a fat percent of maximum 3-3.5 % and that of coconut milk is 27-33%. Ice cream should have a fat percent of 10-12%. The challenge is to decrease the coconut milk fat to 10-11% either by cream separation or by

Coconut milk based ice cream

This is another innovation mainly formulated in response to the demand by one of the coconut processing industries to target the common public. Here, the fat source is coconut milk. In the view of the cost of tender nut, skimmed milk powder was used as source for Solids Non Fat (SNF). Refined suagr was used as sweetner. The product is having a total fat content of 11%. The standardized formulation was commercialized to M/s. Dinesh foods, Kannur. For technology support for coconut based delicacies, entrepreneurs can contact ICAR- CPCRI.

dilution. Efforts were made to optimize the level of ingredient and machine parameters for getting an acceptable product. The optimized product was named as 'Frozen Coconut delicacy'.

FROZEN COCONUT DELICACY

The delicacy envisaged has exclusive coconut products such as coconut milk and tender coconut (pulp and water), coconut sugar apart from other ingredients such as stabilizer and emulsifier. Suitable stabilizes and emulsifiers for coconut milk were standardized. Here the fat content of coconut milk is reduced to 11%. The methodology followed were mixing, pasteurization at 75°C for 15 min, two stage homogenization at 2000 psi/ 1000 psi, ageing for an hour at 4°C, and freezing using a continuous freezer (-5°C) and hardening at -28°C.

The technology was commercialized to M/s. Hangyo Ice creams Pvt. Ltd. The firm has branded it as 'Vegan Coconut Delicacy'. Cocoa flavoured delicacy

was also made and named as 'Choconut'. It is a premium product and was launched by Shri. Radha Mohan Singh, the then Honorable Union Minister of Agriculture and Farmers' Welfare at New Delhi during the 90th ICAR foundation day celebration held on 16th July 2018. With the help of Coconut Development Board, Kochi an ice cream plant was established at ICAR-CPCRI, Kasaragod.

Cost economics of frozen coconut delicacy (100 Litre mix)	
Particulars	Economic analysis of Frozen coconut delicacy made of Coconut milk + Coconut sugar + tender coconut (Rs.)
Cost of Machinery	
(50 L capacity)	18,60,000
Working capital	76,36,000
Selling cost	150/L
Unit cost of production	81.02258
Breakeven period	58.0683
Net profit %	46

[1] *ICAR - Central Plantation Crops Research Institute, India*

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THE POTENTIAL OF COCONUT OIL AND ITS DERIVATIVES AS EFFECTIVE AND SAFE ANTIVIRAL AGENTS AGAINST THE NOVEL CORONAVIRUS (NCOV-2019)

Fabian M. Dayrit[1] & Mary T. Newport [2]

As we write this, the World Health Organization has declared a global emergency over the novel coronavirus, nCoV-2019, that has spread beyond China. There is still no cure for nCoV-2019. nCoV2019 has been shown to be related to SARS (Zhou *et al*., 2020), a coronavirus which caused an outbreak in 2003. Several researchers have been designing drugs to specifically target protease enzymes in coronavirus, but testing for these drugs is many months away. What if there is a treatment candidate against the coronavirus that might already be available and whose safety is already established? Lauric acid (C12) and monolaurin, its derivative, have been known for many years to have significant antiviral activity. Lauric acid is a medium-chain fatty acid which makes up about 50% of coconut oil; monolaurin is a metabolite that is naturally produced by the body's own enzymes upon ingestion of coconut oil and is also available in pure form as a supplement. Sodium lauryl sulfate, a common surfactant that is made from lauric acid, has been shown to have potent antiviral properties. Lauric acid, monolaurin, and sodium lauryl sulfate (which is also known as sodium dodecyl sulfate) are used in a wide range of products for their antiviral properties.

MECHANISMS OF ACTION

Three mechanisms have been proposed to explain the antiviral activity of lauric acid and monolaurin: first, they cause disintegration of the virus envelope; second, they can inhibit late maturation stage in the virus replicative cycle; and third, they can prevent the binding of viral proteins to the host cell membrane.

1. Disintegration of the virus membrane. The antiviral activities of lauric acid and monolaurin were first noted by Sands and co-workers (1979) and later by Hierholzer & Kabara (1982). In particular, Hierholzer & Kabara showed that monolaurin was able to reduce infectivity of 14 human RNA and DNA enveloped viruses in cell

culture by >99.9%, and that monolaurin acted by disintegrating the virus envelope. Thormar and co-workers (1987) confirmed the ability of lauric acid and monolaurin to inactivate viruses by disintegration of the cell membrane. Sodium lauryl sulfate has been shown to be able to solubilize and denature the viral envelope (Piret 2000, 2002).

2. Inhibits virus maturation. The Junin virus (JUNV) is the causative agent of Argentine hemorrhagic fever. In a comparison among the saturated fatty acids from C10 to C18 against JUNV infection, Bartolotta and co-workers (2001) showed that lauric acid was the most active inhibitor. From mechanistic studies, it was concluded that lauric acid inhibited a late 2 maturation stage in the replicative cycle of JUNV. From transmission electron microscope images, JUNV is an enveloped virus featuring glycoproteins that are embedded in the lipid bilayer forming viral spikes (Grant *et al*., 2012); this is similar to nCoV2019.
3. Prevents binding of viral proteins to the host cell membrane. Hornung and co-workers (1994) showed that in the presence of lauric acid, the production of infectious vesicular stomatitis virus was inhibited in a dose-dependent and reversible manner: after removal of lauric acid, the antiviral effect disappeared. They observed that lauric acid did not influence viral membrane (M) protein synthesis, but prevented the binding of viral M proteins to the host cell membrane.

Although lauric acid accounts for much of the reported antiviral activity of coconut oil, capric acid (C10) and monocaprin have also shown promising activity against other viruses, such as HIV-1 (Kristmundsdóttir *et al*., 1999). Capric acid accounts for about 7% of coconut oil. Thus, at least two fatty acids in coconut oil, and their monoglycerides, have antiviral properties. Hilarsson and co-workers (2007) tested virucidal activities of fatty acids, monoglycerides and fatty alcohols against respiratory syncytial virus (RSV) and human parainfluenza virus type 2 (HPIV2) at different concentrations, times and pH levels. They reported the most active compound tested was monocaprin (C10), which also showed activity against influenza A virus and significant virucidal activities even at a concentration as low as 0.06-0.12%. Use of coconut oil and C12 derivatives in animals and humans.

Coconut oil and its derivatives have been shown to be safe and effective antiviral compounds in both humans and animals. Because of the antiviral and antibacterial protection that it provides to animals, coconut oil, as well as lauric acid and monolaurin, is used in farm animals and pets as veterinary feed supplements in chicken, swine and dogs (Baltic *et al*., 2017). Monolaurin has been shown to effectively protect chicken against avian influenza virus (van der Sluis, 2015). Li and coworkers (2009) prepared a gel containing monolaurin and is found to be highly active against repeated high viral loads of Simean immunodeficiency virus in macaques and Kirtane and coworkers (2017) developed a 35% gel of monolaurin for application in the female genital tract to protect against HIV. Sodium lauryl sulfate (SLS) has been used at low concentrations to inactivate viruses in milk of farm animals (de Sousa et al., 2019). SLS is the active constituent in commercial disinfecting wipes and standard laboratory disinfectants, and is an

emulsifying agent and penetration enhancer in pharmaceutical preparations.

Coconut oil itself has been shown to have anti-HIV properties in small clinical studies. The first clinical trial using coconut oil (45 mL daily) and monolaurin (95% purity, 800 mg daily) against HIV-AIDS was conducted in the Philippines. This study involved 15 HIV patients, aged 22 to 38 years, 5 males and 10 females, for 6 months. There was only one fatality and 11 of the patients showed higher CD4 and CD8 counts after 6 months (Dayrit, 2000).

In another study, 40 HIV subjects with CD4+ T lymphocyte counts less than 200 cells/microliter were divided into a virgin coconut oil (VCO) group (45 mL daily) and control group (no VCO). After 6 weeks, the VCO group showed significantly higher average CD4+ T lymphocyte counts versus control (Widhiarta, 2016).

CONCLUSION

Several in vitro, animal, and human studies support the potential of coconut oil, lauric acid and its derivatives as effective and safe agents against a virus like nCoV-2019. Mechanistic studies on other viruses show that at least three mechanisms may be operating. Given the considerable scientific evidence for the antiviral activity of coconut oil, lauric acid and its derivatives and their general safety, and the absence of a cure for nCoV-2019, we urge that clinical studies be conducted among patients who have been infected with nCoV-2019 (see below). This treatment is affordable and virtually risk-free, and the potential benefits are enormous. On the other hand, given the safety and broad availability of virgin coconut oil (VCO), we recommend that VCO be considered as a general prophylactic against viral and microbial infection.

A PROPOSED CLINICAL STUDY

We can propose that a clinical study be conducted on patients infected with nCoV-2019 accordingly:

- Group 1: Control group, standard care
- Group 2: standard care + VCO (45 mL, approx. 3 three tablespoons, daily or higher,)
- Group 3: standard care + Monolaurin (95% purity, 800 mg daily). Monolaurin is recognized as GRAS by US FDA.
- Group 4: standard care + Monocaprin (95% purity, 800 mg daily). Monocaprin is recognized as GRAS by US FDA.
- Group 5: standard care + SLS (pharmaceutical grade, 100 mg/kg/day). SLS toxicity: lowest NOAEL (repeated dose, rat): 100 mg/kg/day (hepatotoxicity) (Bondi *et al*., 2015).

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CLIMATE CHANGE, CARBON SEQUESTRATION AND COCONUT BASED ECOSYSTEM

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Climate change is a key issue of the present day. It refers to gradual increase in temperature and the consequent effect on the atmosphere. Today what we are experiencing is believed to be caused by the increase in atmospheric concentration of carbon dioxide and other green house gases. Several global initiatives have been launched to address this issue. Coconut based cropping system provides good opportunities for enhancing carbon sequestration through different perennial and annual crop combinations such as spice crops, tree crops, tuber crops and food crops. A study was initiated in 30 year old D x T coconut plantation at Regional Coconut Research Station, Bhatye, Ratnagiri (MS) under All India co-ordinated research Project on palms during 2013-14 and 2017-18. The component crops were nutmeg, cinnamon, banana and pineapple. The main focus of the study was yield maximization, carbon sequestration and employment generation potentiality generated through coconut based cropping system. Generating and establishing more sustainable cropping system is one of the needs of the hour. Multispecies and multi-storeyed cropping system ensures maximum utilization of resources for higher yield per unit area. There are many coconut based cropping systems in various countries and in India. Effective and efficient utilization of available resources for higher yield is the modern concept of cropping system. Improvement in the soil properties and biological activities in the rhizosphere due to intercropping results in the modification of soil environment for the benefit of the plant growth. Studies revealed that natural resources i.e. soil, water; air space and solar reclamation are not fully utilized under the spacing schedule 7.5 m x 7.5 m. It is reported that a well designed high density multispecies crop model suited to a given agroclimatic situation generates biomass output, yields.

ECONOMIC AND SOCIAL IMPORTANCE

Coconut is an important crop of economic importance to many of the Asian and Pacific countries in the world. The crop provides livelihood security and employment opportunities to a major segment of the rural mass of these countries. India being the largest coconut producing country in the world occupies 31% of the global production. Widely acclaimed as Kalpavriksha or Tree of life, the coconut palm provides food security and livelihood

more economic and higher total income, additional employment opportunities for family labours and meets the diversified needs of the coconut farmers, such as food, fruit, vegetables, fuel etc. The coconut based cropping systems are gaining importance as there are serious market fluctuations for coconuts and coconut products. Systematic mixed cropping of compatible crops under coconut to compensate the economic losses of sole cropping by increasing income per unit of cultivable land has become a necessity opportunities to more than 10 million people in India. It is an important food crop for the major chunk of Indian population. Similarly it is an important cash crop for more than 10 million farm families and a fiber-yielding crop for more than 15,000 coir based industries which provides employment to nearly six lakhs workers of which 80 per cent are women folk. Coconut and coconut products are gaining global importance as a contributing factor to the health, nutrition and wellbeing of human being. This is due to its multiple medicinal and nutraceutical properties being revealed day by day. This new development in health sector brought in an unprecedented increase in the demand for coconut products in the domestic and international markets. It is estimated that there are 5 million coconut holdings and 12 million farmers in the country.

COCONUT BASED CROPPING SYSTEM DEMONSTRATING CARBON SEQUESTRATION

Agriculture can be a primary solution to the problem of greenhouse gas emissions and climate change. As a result, farmers are now familiar with terms like carbon credit, carbon financing and carbon payments.

The issue of climate change revolves primarily around the main atmospheric form of carbon, CO_2. In fact, CO_2 is the metric, or currency in which changes in atmospheric radioactive forcing (i.e., global warming) are measured. The most effective way to reduce atmospheric CO_2 levels is through Mother Nature's own process of photosynthesis. A few simple, back of the envelope calculations demonstrate agriculture's ability to assimilate CO_2, which can potentially lead to carbon capture and storage. Let's use coconut, the nation's plantation crop, as an example. In this experiment we have compared the coconut based cropping system with monocrop coconut.

Table: Details of the component crops in coconut cropping system/ha.

Sr. No.	Name of the crop	Varieties/hybrids	Number of plants/ block	Number of plants/ ha
1.	Coconut	D x T (COD x WCT)	20	175
2.	Nutmeg	KonkanSwad	12	135
3.	Cinnamon	KonkanTej	62	615
4.	Banana	KonkanSafedVelchi	62	615
5.	Pineapple	Kew	960	10800

ABOVE GROUND CARBON SEQUESTRATION OF CROPS

It was observed that, among the different integrated nutrient management systems, the above ground standing biomass (SDW) and above ground carbon stock (353.25 kg/plant and 31.06 t/ha, respectively) was significantly the highest in coconut based cropping system. The lowest above ground biomass and carbon stock were observed in coconut monocrop (288.8 kg/plant and 25.6 t/ha, respectively). This is because the intercrops in coconut based cropping system have added additional biomass production than monocrop. Hence the carbon stock was the highest in the cropping system plots compared to monocrop of coconut. Furthermore, the CO_2 sequestered also followed the same trend and accordingly, the highest CO_2 sequestration was recorded in coconut based cropping system, whereas the lowest CO_2 sequestration was noticed in coconut monocrop (93.8 t/ha). Trees are carbon reservoir on earth and in nature, forest ecosystem act as a reservoir of carbon and store huge quantity of carbon and regulate the carbon cycle by exchange of CO_2 from the atmosphere. Thus, forest ecosystem plays a significant role in the global carbon cycle by sequestering a substantial amount of carbon dioxide from the atmosphere by storing it in the biosphere.

SOIL BULK DENSITY AND ORGANIC CARBON

The bulk density of soil (g/cm^3), soil organic carbon (%) and soil carbon stock (t/ha) is at 0-30 and 31-60 cm depth in the rhizosphere of different crops in the system. With respect to bulk density, no significant


Picture from: iriecoco.com

difference was found among the different cropping system and INM practices at both the depths during the course of study. The organic carbon (OC) content differed significantly among the cropping systems at both the depths. Among the different crops, significantly the highest soil organic carbon (0.86% and 0.81%) was documented in coconut basin at 0-30 and 31-60 cm depth in fully organic managed garden. The coconut basin in the monocropping system recorded significantly the lowest organic carbon at both the depths (0.60 and 0.51 %). The rhizosphere of intercrops like nutmeg, cinnamon, pineapple and banana also recorded higher organic carbon content, whereas in the interspace of monocropping, it was found significantly lower (0.46 and 0.44 %). Growing intercrops in the coconut garden has lead to addition of recyclable biomass from the intercrops which has resulted in improvement in the organic carbon content.

SOIL CARBON STOCK

The soil carbon stock was significantly influenced by coconut based cropping system. Among the different crops under investigation, the coconut rhizosphere had significantly higher soil carbon stock (42.31 t/ha and 39.85 t/ha) in the depths of 0-30 and 31-60 cm. The lowest soil carbon stock of 28.44 t/ha and 24.17 t/ha at 0-30 and 30-60 cm depth was noticed in the coconut rhizosphere in the monocropping system. Significantly the highest soil carbon stock was observed in coconut based cropping system at 0-30 and 31-60 cm depth in the rhizosphere of different crops. The lowest soil carbon stock observed in the coconut monocrop might be due to the absence of intercrops in the interspace which might not have contributed to soil carbon pool. Furthermore, the coconut basin rhizosphere has recorded higher carbon stock at both depths (0-30 and 31-60 cm), which might be due to increase in organic carbon in the soil owing to decomposition of root system over a period of time as compared to other crops and organic manure incorporation to the coconut crop and interaction effect of organic manure and green manure incorporation.

ECONOMICS AND EMPLOYMENT GENERATION UNDER COCONUT BASED CROPPING SYSTEM

a) Economics

The total cost involved in maintaining the coconut based cropping system was Rs. 123769.60 and the net return was Rs. 1,31,605.8 with the highest cost benefit ratio of 1:2.69. Merely monocrop of coconut recorded Rs 38,735 as net return with 1:1.60 cost benefit ratio.

b) Employment generation

The employment potential of coconut based cropping system is observed to be very high. The labour input utilization of irrigated monocrop of coconut (at its stabilized yield stage) is 157 man days/ha/year. The labour utilization in the coconut cropping system with banana, pineapple, cinnamon and nutmeg was 297 days/ha/year. In percentage term, the increase was about 189 per cent over the sole crop system. Since it is expected that the bulk of the labour force is available from the family source of the farmer, family labour income could therefore be considerably raised when coconut based cropping system was adopted.

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TENDER COCONUT HUSK
VARIOUS USES

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The coconut is an important fruit tree around the world, providing food, fuel and fibre for billions of people, especially in tropical and subtropical regions. As the palm has multiple uses it is aptly called the "the tree of life". Coconut and its products are also known as a 'functional food,' since it provides health benefits over and beyond the basic nutrients. At any given time, a coconut palm bears 12 different types of nuts ranging from the stage of flower opening to ripened nut. Tender coconut (6-7 months maturity) water, the liquid endosperm inside the nut, is a wholesome and nutritious drink. It has an important role to play in the rapidly expanding functional foods market particularly nutraceuticals and pharmaceuticals.

The consumption of tender coconut water is prevalent in countries such as India. Accordingly, increase in the consumption of tender coconut water across various countries has led to expansion of market for coconut water during the last few years. Coconut water is the nutritious clear liquid inside the coconut fruit which is rich in vitamins and minerals. The amount of coconut water that can be harvested from each nut depends on the stage of maturity and the variety.

The increased consumption of tender coconut water has caused an increase in the generation of by products, such as the husk, which corresponds to approximately 60-65% of the fruit weight. The husks are generally discarded on embankments and left in the open environment as waste, where it takes eight to ten years to degrade (Corradini *et al.* 2009). Hence, consumption of tender nut water causes the generation and accumulation of bio-waste. As a result, contamination of the soil has become a problem. Moreover, husks are the breeding ground of mosquitoes and other insects. Due to this, cities like Mumbai have banned the shops of tender coconut near hospitals. Therefore, there is a need for finding novel ways to use the husks from tender coconuts, particularly for value addition. This is because the fibers which is obtained from

the mesocarp of coconuts, are cheap, recyclable, abundant and nonpoisonous (Satyanarayana *et al*. 2007). Additionally, coir fiber is a versatile material, with applications in various engineering sectors, including the development of sustainable construction materials (Ali, 2010).

Tender coconut husk find multitude of applications. Some of the current uses of tender coconut husk includes- the fibre extracted from tender coconut husk is used in production of floor mats, door mats, brushes and mattresses, white coir harvested from unripe coconuts is used for making fine brushes, rope, and fishing nets. Young coconut husk can be converted into ash and used as partial cement replacement in masonry application, dried tender coconut husk can be used for production of bio char, activated carbon, etc. The texture of tender coconut husk is generally smooth and has a very high moisture content of about 80-85%. The rigidity of tender coconut is mainly attributed to its lignin content. Another major application of tender coconut husk is its conversion into convenient form of fuel for clean combustion.

The recent applications of tender coconut husk are highlighted in the present paper.

Fuel for clean combustion

The tender coconut husk is in the soft form but it contains high moisture content with adequate fuel efficiency. Hence, processing the tender coconut husk could offer a valuable clean combustion fuel. The processed tender coconut fuel finds use in cooking. The methodology followed in the production of fuel from tender coconut husk involves the dewatering of the husk followed by drying and further processing to produce sustainable fuel which can be used as a fuel wood alternative. The shredded tender husk is used for fuel production and processing so that it could be used in domestic and community cooking applications.

Bio-oil production

Because of its high volatile matter content, coconut husk can be used for the production of bio oil. The main biochemical components of husk include lignin, cellulose and hemicellulose. Bio oil is a liquid which is produced by steam condensation process from the pyrolysis process. The sub components such as lignin, hemicellulose and cellulose are oxidised to phenolic compounds as the main component of bio oil (Fardhyanti and Damayanti, 2017).

Second generation Bio ethanol

By following the lignocellulosic ethanol production process, a fuel with the highest ethanol concentration per mass of initial substrate for the lowest price, less energy consumption could be made from tender coconut husk. The general processing steps adopted include –pre-treatment of coconut husk (alkaline, acid or other), hydrolysis (enzymatic/acid) and fermentation. The highest ethanol concentration was obtained using alkaline pre-treatment and acid hydrolysis (Maria bolivar-Telleria *et al*., 2018).

Handmade papers and garden articles

Handmade papers and garden articles can be made from organosolv pulp (organosolv pulp involving hydrolysis and removal of lignin with an organic solvent). The pulp is usually diluted with water and poured uniformly over a screen. The wet pulp

is then transferred to a cloth to remove excess water. As water drains, the fibres become closer, and after pressing and drying, calendaring of the handmade paper is done. The pulp can also be utilised in making paper plates, cups, glass covers, and garden articles such as paper pots for seedling and packaging by moulding into the desired shape and size.

Partial cement replacement in masonry application

The discarded tender coconut husks with their shells were collected and burnt at about 600˚C to produce ash that was mixed with fine aggregates and water as partial replacement of cement. Watercement ratio of 0.485 and proportion of sand to cement is 1:2.75. The research findings stated that the suitability of using young coconut husk ash (YCHA) as cement replacement for concrete masonry application in the construction industry. The compressive strength obtained at 20% and 40% YCHA designed mixtures provide favourable conditions for masonry applications (Olan *et al*., 2016).

Bio char production

Bio char can be produced by the thermochemical degradation of biomass in a zero or limited oxygen environment through the process of pyrolysis. It is perhaps the most recalcitrant form of organic matter in soil, which sustenance extends from few hundreds to thousands of years, rendering it an excellent means for carbon sequestration. It improves the chemical properties of soil. Owing to the highly porous nature of bio char, soil application of bio char would ultimately lead to an enhancement of a wide range of soil physical, chemical and biological properties (Atkinson *et al*., 2010). The bio char production process involves sun drying of the coconut biomass residues until the moisture contents of the feed stocks reduce considerably. The dried feedstock was then layered into the kiln and heated at fluctuating temperatures of 350–450˚C range for 2–6 hr for producing the bio chars. The colour of the smoke was used as a visual indicator for the process of carbonization. No harvesting of the volatiles released during the process was adopted. Once the material was carbonized (turned black colour) through partial combustion, water was sprinkled over the hot bio char and allowed to cool. The cooled bio chars were then crushed to coarse particles and stored.

Production of activated carbon

Activated carbon can be prepared from tender coconut husk by physicochemical activation method consisting of potassium hydroxide treatment and carbon dioxide gasification. The activated carbon preparation conditions were optimized by maximizing both the 2, 4, 6 trichlorophenol (TCP) uptake and the activated carbon yield (Tan, Ahmad, and Hameed, 2008). The production process is generally carried out in 3 stages namely- determination of lignin content, carbonization and activation step. The activated carbon thus obtained find use in several applications such as filtering of fruit juices, waste water treatment, etc., (Pattananandecha *et al*., 2019). Coconut-based activated carbon generally have the most micro porous pore structure, and possess the highest hardness compared to other types of activated carbon. Thus it is considered the best carbon for water filtration and it generates the least ash during production.

Mattresses

Rubberized coir is a versatile product used largely as a less expensive substitute cushioning material for foam rubber in furniture, upholstery, and mattresses. Rubberized coir is made from curled fiber, which should be free from dust. The coir is made into endless fleece which is conveyed to the first set of rubber latex spray gums. Thickness of sheets is built by fixing multi layers fleeces

and spraying is repeated to get a good bonding of layers. Then the sheet is hydraulically pressed and vulcanized to set the fibers. Rubberized Coir Mattress is made out of Rubberized Coir Sheets and Natural Latex Form Sheets. Rubberized Coir Mattress is gaining economic importance due to its high strength and durability among the market. The advantages of coir mattresses over the conventional are reliable, high strength, dimensionally accurate, and durable. The rubberized coir mattresses are widely accepted as bed for modern living style.

CONCLUSION

Tender coconut husk is accumulated as a bio waste in road side. The proper utilization of tender coconut husk will increase the income to coconut growers, street vendors and farmer's producer companies. However, there is no potential cost effective technology for proper utilization of husk. In this context, ICARCPCRI is working on the area of value addition of tender coconut husk.

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JOINT VISIT OF ICC AND NAM-CSSTC TO LAMPUNG PROVINCE

Otniel Sintoro[1]

The team of ICC and NAM-CSSTC, Jakarta have visited Lampung Province, one of the Indonesia's biggest coconut producing province from 5-9 April 2021. The ICC team was led by Dr. Jelfina C. Alouw, Executive Director; accompanied by Ms. Mridula, Assistant Director; Mr. Alit Pirmansah, Marketing & Statistics Officer; Mr. Otniel Sintoro, Information & Publication Officer, and Ms. Sri Hartati, Administrative Assistant. While the NAM-CSSTC team consisted were H.E. Ambassador, Mr. Diar Nurbintoro, Mr. Edi Supriyatno, Mr. Suroso, and Mr. Syahroni.

The main purpose of the field visit was to comprehend the current situation of coconut industry and to update and absorb inputs from the coconut stakeholders, by which the NAM-CSSTC and ICC can identify their needs and accordingly relevant collaborative capacity building programs for member countries would be framed in the future. ICC and NAM-CSSTC is serving as a mediator to the government in sharing the inputs for amendment in the existing regulations regarding unauthorised transshiftment of fresh coconut to other countries causing shortage of raw materials for the coconut industry in the country.

The first industry visited was PT. Mahligai Indococo Fiber, a cocopeat and coco fiber producer located in Tanjung Sari, South Lampung regency. Mr. Efli Ramli, President Director of PT Mahligai Indococo Fiber (PT MIF) who is also chairman of the Indonesian Coconut Fiber Industry Association stated that Indonesia has the largest coconut plantation in the world but only

Coconut fiber as a valuable material of PT Mahligai Indococo Fiber

meets 3% of the world's coconut fiber needs. Most coconut husks are simply wasted without being processed, even burned. In its 7 locations, PT MIF has succeeded in processing coco peat and coco fiber and exported its product to several countries. Coconut fiber is the raw material of the industrial mattress, geotextile, rope, carpet, doormat, and stable mat, while coco peat was used for plantation media and horse bedding. PT. MIF monthly exports 30 containers of coco fiber and 35 tons of coco peat.

Packed fiber

PT. Mahligai Indococo Fiber was established in 2007, but the factory started the operation from 1995 which previously used to produce rattan furniture. It has 7 production clusters in Lampung, 8 ha each, with a capacity of 2 tons/day each, which are processed from an average of 15,000 coconuts. Each cluster employs 20 people. The seven clusters are located in the villages of Tanjungsari, Jatibaru, Krui, Wonosobo, Negeri Katon, Padang Cermin, and Pasar Minggu. According to Mr. Efli, the market is not a problem. The availability of raw material is one of the main problem besides the weather.

The team secondly visited to integrated coconut value-added food product manufacturer of PT Sari Segar Husada, Tarakan, North Lampung. The unit is established in 1991, the main products they produces are desiccated coconut, coco milk/ cream, coco water, nata de coco, crude coconut oil and coco expeller, under the brand of Rose Brand. The factory site location is strategic, only 8 km from Panjang International Port, and 37 km from Raden Intan Airport. With 1,500 employees, the factory occupies an area of 8 ha, the products are exported to Asia (8%), Australia (6%), Europe (49%), the USA (16%), Africa (3%), and domestic (18%). Mr. Hendrajaya, Assistant General Manager, explained the production process and activities of the unit.

Activities in PT. Sari Segar Husada

There was an in-depth discussion on different issues related to processing; raw material availability; marketing in which Dr. Jelfina C. Alouw and H.E. Ambassador Diar Nurbintoro also participated and assured that they will take the problem identified about non availability of sufficient raw material to the concerned Government authority. Dr. Jelfina underlined the importance of coconut replanting and implementation of a polyculture system to address the raw material requirement.

The team also visited the Food, Crops, Horticulture, and Estate Crops Service, South Lampung Regency. Met with Mr. Bibit Purwanto, S.P., M.M, Head of Office. They are maintaining a tissue culture laboratory in which conducting research on tissue culture of clove, pepper, durian, banana, klengkeng, orchid, and kopyor coconut since 2017. Mr. Adi Saftiadi, Head of Tissue Culture Laboratory, and Mr. Epiphan Asrido IP, S.P., M.M, Section Head of the Plantation Production explained the tissue culture process of Kopyor Coconut. It has been in the acclimatization process before the seeds being moved to the garden. Kopyor Coconut has more than 10 times the economic value than regular coconut.

The last unit visited was Nata de Coco production unit, TH Brothers Coco, owned by Mr. Derry Kusuma

Packaging of branded coconut milk

at Rawa Selapan village, Candipuro district. Mr. Derry was earlier working with a food factory where he saw the wastage of coconut water and got motivated and started this unit.

Mr. Derry is a young entrepreneur doing value-added products from coconut water. He established the unit in 2011 with a capital outlay of IDR 150,000,000 (US$ 10,344). The unit can produce 40 tons of Nata de coco per week. Mr. Derry explained the processing of Nata de coco by demonstrating the different stages of the processing. He used to collect the coconut water from the copra manufacturers locally. He is having processing unit in 13 locations, each has a production capacity of 200 tons/month

Kopyor coconut demonstrated by the Food, Crops, Horticulture, and Estate Crops Service

Tissue culture laboratory of kopyor coconut

Processing of nata de coco in TH Brothers Coco

where the processing till the making of the sheet is being carried out. The final processing is being done here in the main factory. Around 20 labors are engaged in the factory for attending different work which includes both ladies and gents.

The visit was very learning and productive to know more about the processing of value added products of coconuts at different levels and to understand the problems faced by the units. During the visit to each of the unit , Dr. Jelfina, Executive Director ICC presented the ICC plaque of appreciation and publications to the processors.

[1] *Information and Publication Officer, International Coconut Community*

VISIT TO MOROTAI ISLAND REGENCY, NORTH MALUKU

Mridula Kottekate[1]

Team of ICC, Balit Palma and Village Officers of Morotai Island Regency

Dr. Jelfina C. Alouw, Executive Director, and Ms. Mridula Kottekate, Assistant Director, ICC, visited Morotai Island Regency from 19th to 24th March 2021.

Team of Balit Palma, Manado, North Sulawesi under the leadership Prof. Meldy L. A.Hosang, Ms., Sukmawati Mawardi, a coconut breeder, and Ms. Juniaty Kalesaran Sundalangi, an Entomologist, also joined the ICC team at Morotai Island Regency. The main objective of the visit is to do survey to assess the current situation relating to coconut palms showing symptom similar to Phytoplasma infection and to collect the sample from coconut garden at Morotai as informed by scientist from Balit Palma. This visit was as part of the activities under the International Thematic Action Group (ITAG) 3 of COGENT "Phytopathology, Entomology and Germplasm Movement". The sample collected would be identified in the molecular laboratory at Bogor, Indonesia, to know the actual cause of infestation so that early intervention can be recommended to the government.

During the visit, the team visited the Bido village around 30 km away from the Pandanga, Morotai, where the variety of Bido planted. Met with the Village Head, Mr. Yosua Banggai, Dr. Jelfina explained the objective of visiting the village and briefed the activities of ICC. During interaction, Mr. Yosua Banggai informed that the village is planning to prepare a coconut nursery of Bido variety in an area of 10 ha to meet the local demand for planting materials. The variety is cultivated in an area of 200 ha covering 67 families. The palms are of age from 40 years old and almost all the palms are giving good yield.

The team had a meeting with Mr. Asrun Pandoma, Vice Regent of Morotai Island Regency, along with the local officers, Mr. Anwar Husen, Head of Agriculture and Food Security Department;

Mr. Marwan S., Capacity Building and Industry Department; Mr. Taufik, Quarantine Officer.

Dr. Jelfina explained the objective of the visit of the team and made a presentation on ICC activities and briefed the Vice Regent on the different value-added products made out of coconut. She brought to the notice of the Vice Regent that the scientists from Balit Palma have observed some disease infestation in the coconut plantation of the Morotai Regency. There was in-depth discussion on different issues in which the team of Balit Palma also participated. Dr. Meldy informed the Vice Regent that Balit Palma is carrying out different research activities in the Morotai Island Regency from last few years. Mr. Anwar Husen, the Head of the Agriculture Service, Morotai Island Regency explained the activities of his department in the regency and mentioned that here the farmers are only making copra traditionally from the coconut. It would be appreciated if some capacity building programs could be arranged in association with Balit Palma for the local farmers. He mentioned one coconut variety DUKU in the regency, the size of which looks like papaya fruit.

Dr. Jelfina presented the ICC's Publications to Vice Regent and to Head of Agriculture Department. Token of appreciation was exchanged between Vice Regent and Executive Director.

The ICC team collected the sample from the coconut garden infested with the symptom similar to phytoplasma related disease. The sample was collected in the presence of Mr. Taufik, the Local Quarantine Officer, and Ms. Salma Lahia, Pandanga Guide and Local Representative. The visit was very informative and productive.

[1] *Assistant Director, International Coconut Community*

Coconut Bido Variety cultivated in Morotai

WEBINAR ON BEST PRACTICES FOR COCONUT HUSK PRODUCT DEVELOPMENT: FROM INITIAL CONCEPTS TO MARKET SUCCESS

Otniel Sintoro[1] & Mridula Kottekate[2]

Continuing with the second phase of the implementation of the MOU between ICC and NAM-Center, the first webinar of CY 2021 was organized on "Best Practices for Coconut Husk Product Development: from Initial Concepts to Market Success" on 8th June 2021. There were 298 registered participants which included representatives from the ICC and NAM-CSSTC countries, scientists, UNDP staff, senior officials, private sectors, stakeholders and farmers.

Dr. Jelfina C. Alouw, Executive Director, ICC, delivered the welcome speech. She mentioned that by organizing and implementing such programs, ICC Secretariat ensures its commitment to serve member countries to achieve ICC's vision of improving the socio-economic welfare of the farmers and other stakeholders in the vibrant coconut sector. The objectives of this webinar is to raise awareness that coconut husk can be feasibly processed into a variety of marketable profitable products. The market demand for coconut-based products is increasing and projection for future growth is stronger. Ironically, with the global production of 67.5 billion nuts, about 90% of the coconut husk in most coconut producing countries is disposed of as waste, and only a small portion has been processed into profitable, durable, healthy, and eco-friendly products.

She also highlighted the involvement of the millennials and women as entrepreneurs in the coconut sector. Two of the resource speakers are millennial and woman who are involved in the coconut coir business. The millennials generation and others are expected to make a profound contribution to achieve sustainable development goals and sustaining the coconut sector. The use of choir-based products becomes an alternative to save the environment and to save the world. She hoped that the webinar inspired ideas and discussions around the development of a business plan for coconut husk-based products, for the local and global market, for the benefit of coconut farmers and their families and supporting the resilience and sustainable coconut industry.

In his opening speech, His Excellency Mr. Mahendra Siregar, Vice-Minister of Foreign Affairs, Republic

Vice Minister Mahendra Siregar, delivering his speech

of Indonesia, appreciated the high-level engagement and exchanges between experts. The technical skills and deep knowledge, in enhancing the capacity of the coconut stakeholders, exchanging across countries, generation, involving all levels of background and professions. The foreign ministry hoped that other series of collaboration will continue in the future, as a result of the MoU between the NAM-Center and ICC. Besides technical and experience exchanges between multi-stakeholders in this industry, the event also focused on the sustainability of the industry and value chains.

He encouraged the ICC and NAM Centre to continue exploring the opportunities for the stakeholders of the coconut industry to increase the standard and achieving the sustainability levels, with various technology and research. He wished that the participants could optimize the event for their knowledge and benefits, as well as to strengthen the momentum of collaboration and partnership.

The topic of "Economic and Environmental Impacts of processing of Coconut Husk-based products" was presented by two speakers. The first speaker, Silvia Ten Houten, Founder GoodHout, the Netherland, underlined the company's values in gender equality, fair-trade supply chain with suppliers, an educational fund for children, continuous education for local employees, and the company's impact on 10 of 17 UN SDGs. She urged the action required to increase sustainability and combat climate change. She also presented the production process of various innovative products from husk as an alternative to wood, applied to home interior, automotive, fashion, and accessories which features a high-end and natural finish.

The second speaker, Galih Batara Muda, founder of Roemah Kelapa Indonesia, presented "Impacts of Processing of Coconut Husk-Based Products". Started with the overview of coconut and husk potential, and explained the serious impact of coconut husk burning and related problems in Indonesia.

Mr. A. Radhakrishnan, Assistant Director, National Coir Training and Design Centre, Coir Board of India, presented "Processing and Development of Coconut Husk-based Products", in which he explained the overview of coir industry in India, which is a traditional, labor-intensive, export-oriented agro-industry, employs more than half a million people in a rural area with about 80% are women. India exported coir to more than 122 countries. The Coir Board was set up for sustainable development of the coir industry, encouraging scientific, technological, and economic research, quality improvement, human resources development, the welfare of those engaged in the industry, and market promotion. He also presented various creative products such as furniture, floor mat, coir wood house, geo-textile, and other value-added coir products, also the training provided by the institution.

Panelist of the Webinar

Mr. S. K. Gowthaman, Consultant and exporter of Coir Based products, India, presented, "Manufacture and Export of Coir and Coir-based Products, Hydroponic". He mentioned that the number of plastic waste generated worldwide which is estimated at 1.6 million ton per day and about 900 million trees are cut down annually. Coir is an alternative eco-friendly substitute to plastic in daily use, such as toothbrushes, doormats, furniture, gardening, packing materials, and children's toys. He also focused on various coco pith products used for hydroponics, medical value plant seed, germination or propagation, enrich coco pith manure, and grow bags for soilless cultivation. The coco pith is advisable and suitable for home gardening.

The last speaker was exceptional because she was a millennial generation. Ms. Febiola Efriani, Vice President, Mahligai Indococo Fiber, PT Indonesia, presented "Marketing Scope of Coconut Husk-based Products", based on her experience in leading the company. The company has been optimizing the digital marketing platforms for the domestic and international markets. Continued with the company's overview, marketing strategies, and competitive advantages, SWOT analysis, and various value-added coco pith products of PT MIF for different countries' markets. A video of the coco pith production process was also played.

Mr. Alit Pirmansah, Marketing and Statistics Officer, ICC, presented a brief marketing data of the global production of coir fiber, export and import demand of coir products, and coir price fluctuation.

Mr. Ambassador Diar Nurbintoro, Acting Director, NAM CSSTC, delivered the closing remarks. He expressed that this event was a significant opportunity for emphasizing the link between sustainable development of coconut sector. Negative campaigns against coconut have a significant negative influence on agriculture, the development of coconut and the farmer's livelihoods. Plantations have been neglected and abandoned at the farmer level; production is barely sufficient to support the basic needs of the farmers. Many farmers still live in poverty. Collaboration between all the stakeholders will lead to greater force in defending coconut against the negative campaign. The diversification and promotion of eco-friendly coconut farming are essential to assist coconut farmers in struggling and sustaining their businesses. Coconut is therefore always an important topic for NAM Centre's activities to remind the efforts to be taken to encourage coconut farmers and enhance their livelihood.

There was in-depth discussion on the topics, and the speakers addressed the queries. The webinar was moderated by Dr. Dedie Tooy, Head of Agricultural Technology Department Faculty of Agriculture, Sam Ratulangi University and member of ICC Technical Working Group.

[1] *Information and Publication Officer, International Coconut Community*

[2] *Assistant Director, International Coconut Community*

AN INTERVIEW WITH

MR. EFLI RAMLI, PRESIDENT DIRECTOR OF PT. MAHLIGAI INDOCOCO FIBER

Mridula Kottekate[1]

In this issue, *Cocoinfo International* would like to introduce the readers a four-time best export award winner entrepreneur, Mr. Efli Ramli, who is the President Director of PT. Mahligai Indococo Fiber, Bandar Lampung.

First of all, thank you very much for agreeing to share your experience with the readers. How and when you started your coco fiber unit?
PT Mahligai Indococo Fiber was established in 2007, but the factory has been operated since 1995 which previously used to produce rattan furniture and completed 26 years in this venture. During the rattan furniture business used to travel a lot for participating in different exhibitions. From there I got an idea to go for this product as the raw material coconut husk was available in plenty and seeing getting wasted.

Who inspired you to go for the coco fiber product?
During an exhibition in Shanghai, China, I happened to meet some friends from India and Sri Lanka. During discussion with them they advised me to go for this business since the raw materials are available plentily. Since I have no idea and knowledge about the product those friends from India and Sri Lanka invited me to their countries where the coco fiber processing is quite common and advanced. So, I take my initial training, knowledge and technology from India and Sri Lanka. Later, by doing I learnt a lot and slowly expanded my business. To be frank, still I am learning.

What are the products you make in your unit?
Initially I started with coco fiber as per demand of China and later expand the business and producing coco peat; bedding materials; grow bags; and peat blocks.

Which all the countries you are exporting your products?
I do export the products to China; Europe; Korea; Israel; Italy; Japan. PT MIF exports 30 containers of coco fiber and 35 tons of coco peat monthly. China's coco fiber demand is 3,000 containers/year, while Eastern Europe's 200 containers. Coco peat demand from China is 3,000 containers/year, Japan 1,500 containers/year, Korea 1,500 containers, Italy 300 containers, Germany 200 containers, Israel 300 containers, and Middle Eastern countries 300 containers.

How's your company is functioning?
PT Mahligai Indococo Fiber has 7 production clusters in Lampung, 8 ha each, with a capacity of 2 tons/day each, which are processed from an average of 15,000 coconuts. Each cluster employs 20 people. The seven clusters are located in the villages of Tanjungsari, Jatibaru, Krui, Wonosobo, Negeri Katon, Padang Cermin, and Pasar Minggu. PT MFI also has production clusters located in Aceh, Padang, Banyuwangi, and Pangandaran.

How many workers are employed in your company? What are the facilities and benefits you provided to your employees?
There are nearly 102 workers are employed in my company which includes both male and females. These workers are staying nearby areas of the factory. Besides salary, I do provide bonus; medical and health insurance to the employees.

What are the major problem experienced in this sector?
The permanent problem in this sector is weather. During rainy season it is very difficult to get the products dry properly which drastically affecting the business. Sunny season is the best for this business. Besides, presently raw material availability also experiencing.

What is the impact of pandemic of Covid-19 in your business?
To be frank during the pandemic of covid-19 outbreak the market for the products increased one and half times. Labour was never a problem for my factory. The factory maintaining and following all protocols and social distancing during the pandemic.

From where you are bringing machineries for your factory?
I do design and manufacture my own machineries as per requirement with the locally available materials. Even I am ready to supply and manufacture the machineries if any needy persons are there.

Do you have any future plans to expand your business?
Yes, I am very much interested in expanding my business. I am getting buyers regularly and I promote my product through social media like LinkedIn, and Facebook. Besides whenever I do participate in the exhibitions; visitors are showing their interest on the products. I never compromise on quality of products. The buyers are invited directly to the factory so that they can make assure of the quality by themselves before placing order.

Did you get any support or assistance from the province government?
No never. The entire business and factory are set up by my own investment and hard work. But my request to the government is that they should encourage the people who are ready to set up such units and provide them with at least technical and small financial support initially.

From some of the photos hanging in your office it is learnt that are you recipient of awards. Can you share the details with the readers?

Yes, I have received the best exporters award four time from the Government of Indonesia during 2005; 2007; 2011 and 2014.

Do you have any advise to the new persons interested to set up any factory in this sector?

Yes, my advice to the persons interested to set up any such unit is that do your work with sincerity, hard work and responsibility. The new ways will always open and take your work easily and can learn more by doing. If anybody is interested to know more about me and my business, they are always welcome to contact me in my no or can mail me any time. I am ready to share my experience; technology and details of machineries with them.

Phone no : +62 812790 3902;
Email : efliramlirtn@yahoo.com

PT. Mahligai Indococo Fiber obtained the Primaniyarta Export Award on 2005, 2007, 2011 & 2014

[1] *Assistant Director, International Coconut Community*

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Dr. Fabian M. Dayrit
Chairman of ICC Scientific Advisory Committee on Health and Professor, Department of Chemistry, Ateneo de Manila University, Academician, National Academy of Science and Technology and President, Integrated Chemists of the Philippines

Upon ingestion, coconut oil produces lauric acid and monolaurin, two compounds that have been known for many years to have significant antiviral activity. Lauric acid is a medium-chain fatty acid that makes up about 50% of coconut oil; monolaurin is a metabolite that is naturally produced by the body's enzymes upon ingestion of coconut oil and is also available in pure form as a supplement. Two mechanisms have been proposed to explain the antiviral activity of lauric acid and monolaurin:

1. **Disintegration of the virus membrane.** Monolaurin was able to reduce the infectivity of 14 human RNA and DNA enveloped viruses in cell culture by >99.9%, and that monolaurin acted by disintegrating the virus envelope. During hand washing, soap effectively destroys bacteria and viruses by dissolving their lipid membrane or envelope.
2. **Inhibition of virus maturation.** The Junin virus (JUNV) is the causative agent of Argentine hemorrhagic fever. In a comparison among the saturated fatty acids from capric acid (C10) to stearic acid (C18) against JUNV infection, lauric acid (C12) was the most active inhibitor. From mechanistic studies, it was concluded that lauric acid inhibited a late maturation stage in the replicative cycle of JUNV.

Source: "The Potential of Coconut Oil as Antiviral & Immunodulatory Agent Against Covid-19", Cocoinfo International, Vol. 27 No. 1, 2020.

Dr. Mary T. Newport
Neonatologist, Spring Hill Neonatology, Inc.
Florida, USA

Coconut oil and its active metabolites, lauric acid and monolaurin have been shown to have immunomodulatory properties in vitro and animal studies. Coconut oil is able to modulate the adaptive immune system, in particular, by enhancing T cells. Dendritic cells treated with lauric acid showed increased capacity for activation of T cells in HIV patients. VCO is also able to modulate immune responses by upregulating neuroprotective factors and suppressing inflammation and oxidative stress. An added benefit of VCO is its antibacterial activity. This is an important feature since many viral infections are accompanied by bacterial infections as well. Bacterial co-infections have been observed in COVID-19 cases.

Source: "The Potential of Coconut Oil as Antiviral & Immunodulatory Agent Against Covid-19", Cocoinfo International, Vol. 27 No. 1, 2020.

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Dr. Bruce Fife

Certified Nutritionist and Doctor of Naturopathic Medicine, and Director, Coconut Research Center, based in USA

In recent years numerous studies have exonerated saturated fat as a cause of heart disease and put to rest the outdated diet-heart disease hypothesis. However, when researchers combined all the highest quality studies on fats and diet that had been done for the past several decades and analyzed them together, they found no correlation between saturated fat consumption and cardiovascular disease and that current dietary restrictions on saturated fat should be revised: In 2018 the Lancet (one of the most prestigious medical journals), published a study involving a team of 37 researchers from 18 countries, gathered data on 135,000 subjects; American Journal of Clinical Nutrition (2017), involved 35,597 participants and in 2010, combined the data from 21 previously published studies, involving over 347,000 subjects; University of Cambridge (2014) combined the data from 72 previously published studies involving more than 600,000 participants from 18 countries. They all concluded that high saturated fat intake was not associated with increased risk of ischemic heart disease. The results confirmed there is no connection between saturated fat intake and heart disease.

It is clear, neither saturated fat nor coconut oil cause or even promote heart disease. Because they raise good HDL cholesterol and lower the cholesterol ratio, if anything, they help to protect against it.

Source: "Is Coconut Oil A Poison?", Cocoinfo International, Golden Jubilee, Special Edition 2019

Dr. Narong Chomchalow

Chairman, Conservation and Development of Coconut Oil of Thailand Forum, Bangkok, Thailand

High level of cholesterol is not the cause of athero-sclerosis that leads to the deposition of plague in the artery, which ends up in having heart disease. The real cause of heart disease is the injury in blood vessel leading to the heart, which is caused by various factors, such as toxin, disease, high blood pressure and stress. If the blood vessel is injured, platelets will be circulated to cure the injury and deposited there to stop bleeding. Other substances such as protein, fats (particularly unsaturated fat such as VCO) and calcium also move there, but not cholesterol, in which only a small amount is circulated and deposited there to be used to constitute the membranes of the newly formed cells.

Source: The Truth about Good, The Bad and The Ugly Fats", Cocoinfo International, Golden Jubilee, Special Edition 2019.

EXPERTS' FINDING
ON THE HEALTH BENEFITS OF COCONUT

Prof. Dr. Rabindarjeet Singh
Lifestyle Science Cluster, Advance Medical and Dental Institute, Universiti Sains Malaysia, Penang, Selangor, Malaysia

Coconut water is sterile at source, very rich in potassium, and contains sodium, chloride, magnesium and carbohydrates, making it a healthier alternative to carbonated drinks including isotonic sports drinks. Apart from the lower calories due to lower sugar content, the non-carbonated coconut water is also a great source for replacing the electrolytes lost during sweating when compared to carbonated drinks. Clinically, coconut water may be used as an oral rehydration aid to replace fluids loss from the gastrointestinal tract in children and adults suffering from diarrhea-induced dehydration, and some cases of constipation as it aids the digestive system. The low-sugar containing coconut water is also a better choice as a flavoured beverage with cardioprotective properties for those with diabetes as well as hypertension. The anti-aging compound cytokinins and other antioxidants found in coconut water may promote cell division and healthier ageing.

Source: XLVI Cocotech Conference 7-11 July 2014, Bandaranaike Memorial International Conference Hall, Colombo, Sri Lanka

Dr. Bruce Fife
Certified Nutritionist and Doctor of Naturopathic Medicine, and Director, Coconut Research Center, based in USA

You cannot say LDL (low density lippoprotein) is bad and HDL (high density lippoprotein) is good. It is more complex than that. There are actually two types of LDL: one small and dense the other large and soft. The large LDL is a good cholesterol the type used to make bile, hormones, and vitamin D--it is essential to life! The small dense LDL is the type that becomes oxidized and can be harmful, as all oxidized lipids can be. Eating coconut oil (and other saturated fats) increases both HDL and the "good" LDL, thus lowering the risk of heart disease. This is one of the reasons why populations that eat a lot of coconut oil have the lowest heart disease rates in the world.

Source: Press Statement, APCC, 21 June 2017

BULLISH MARKET
OF COCONUT OIL IN THE SECOND HALF 2020

Alit Pirmansah[1]

As expected, price of coconut oil (CNO, CIF Rotterdam) considerably leveled up in the first half of 2021. The increased had been observed since the beginning of 2020. The price averaged in 2020 was at US$1,015/MT which was up from US$731/MT a year ago or an increase by 39%. The average price in the first half of 2021 was US$1,554/MT which was 74.4% higher than in 2020 for the same period. The highest price was recorded in May 2021 which reached US$1,684/MT. During July 2020-June 2021, price was ranging from US$886/MT to US$1,684/MT with price volatility of 22%.

Similarly, price of palm kernel oil (PKO) in 2020 also increased and continued to go up until the first half of 2021. In 2020, price of PALM KERNEL OIL rose by 26% to reach US$1,193 in December 2020. The price kept increasing and reached its highest level of US$1,530/MT in May 2021. During July 2020-June 2021, the average price was US$1,162/MT with price volatility of 33%.

Price premium of coconut oil over PALM KERNEL OIL widened from US$95/MT in January 2021 to US$270/MT in June 2021. This price premium naturally brings about a shift in demand at the expense of coconut oil.

High premium price of coconut oil over palm kernel oil made the latter more attractive for buyers. Shift of demand of lauric oils at the expense of coconut oil was inevitably and had been observed since last year. During January-May 2021, US import of coconut oil was recorded a drop by 18.7% to 169,424 MT. Meanwhile, import of palm kernel oil rose by 9.6%% leading to a decrease in total import of the lauric oils. It worth noted that in 2020 US import of coconut oil decreased by 2.4%. At the same time, import of palm kernel oil jumped by 11.5%.

		Jan-May 2020	Jan-May 2021	Change (%)
CNO	Volume (MT)	208,295	169,424	-18.7
	Value (USD'000)	223,537	286,341	28.1
PKO	Volume (MT)	146,638	160,774	9.6
	Value (USD'000)	223,537	286,341	28.1

Source: The U.S. Census Bureau, Economic Indicators Division

Table 1. US Imports of Lauric Oils, January-May 2020/2021

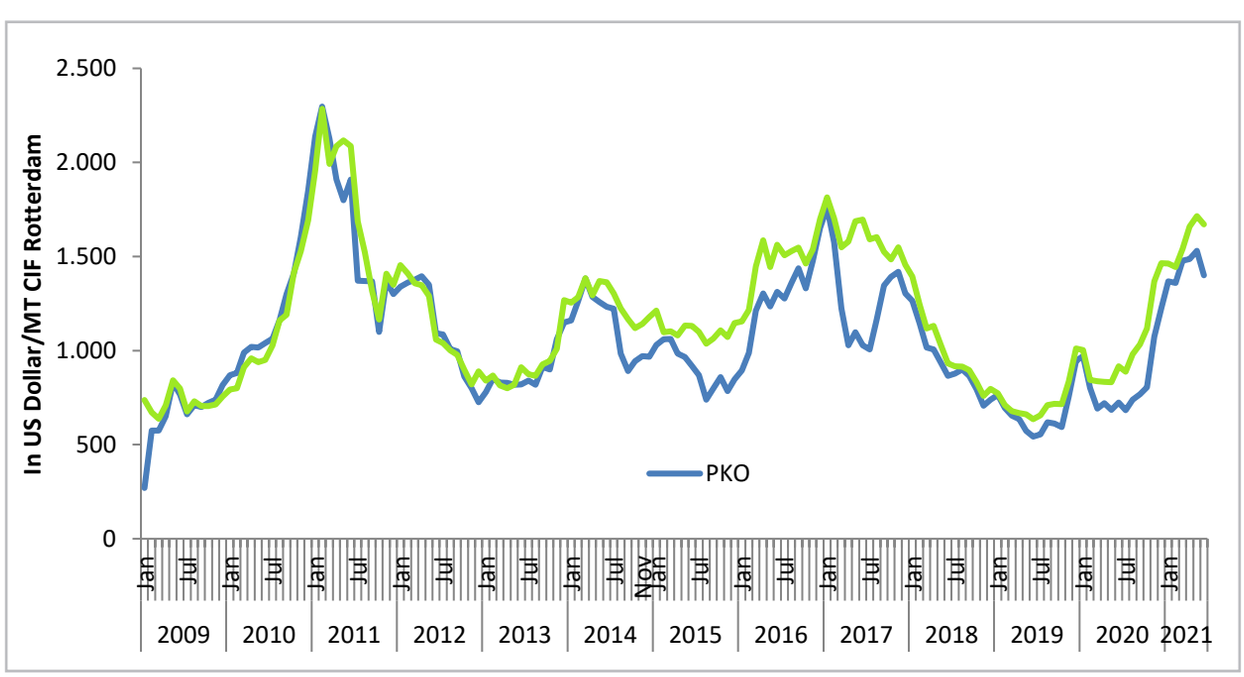

Figure 1. Price Trend of Lauric Oils, January 2008-January 2021 (USD/MT)

A weak demand of lauric oils was also persistent in Europe continent. During period of January-May 2021, imports of the oils by European countries was 710,601 which was 2% lower than the volume a year earlier. Import of coconut oil contributed to the lower import of the oils. Coconut oil import by European countries dropped by 4.8% during the period of January-May 2021. Meanwhile, imports of palm kernel oil slightly increased to 352,713 MT. In 2020, 1.7 million MT of lauric oils was shipped to European countries which was 1.6% lower than that of the import volume a year earlier. However, demand of lauric oil is expected to recover in 2022 following global economic recovery and higher production of the oils.

		Jan-May 2020	Jan-May 2021	Change (%)
CNO	Volume (MT)	394,905	375,888	-4.8
	Value (USD'000)	445,730	547,181	22.8
PKO	Volume (MT)	349,458	352,713	0.9
	Value (USD'000)	345,513	421,676	22.0

Source: ITC

Table 2. European Union (EU28) Imports of Lauric Oils, January – May 2020/2021

Despite the coconut oil price premium demand for coconut oil by Chinese buyers was significantly increased in the first half of 2021. Coconut oil shipments to China went up by 21.7% during January-May 2021 from 63,063 MT to 76,750 MT. Meanwhile, demand for palm kernel oil dropped from 269,717 to 216,176 MT leading to a drop of total imports of lauric oils by 12%. Shipments of palm kernel oil to China were even worse in 2020. China received only 742,424 ton of palm kernel oil or a reduction of more than 20% as opposed to 2019's volume. Combined imports of lauric oils by China in 2020 suffered a setback by almost 0.2 million tons from 1.1 million tons to only 0.9 million tons or shrank by 18%, reflecting a reduction of stocks and consumption. However, China was still the biggest importing country of lauric oils in the world.

The environment of coconut oil market for the second half of 2021 is still expected to have a

		Jan-May 2020	Jan-May 2021	Change (%)
CNO	Volume (MT)	63,063	76,750	21.7
	Value (USD'000)	55,677	115,261	107.0
PKO	Volume (MT)	269,717	216,176	-19.9
	Value (USD'000)	143,016	262,846	83.8

Source: ITC

Table 3. China Imports of Lauric Oils, January – May 2020/2021

moderate recovery in the second half of the year amid a big challenge in shipping and Covid protection measures. A report from Philippine Statistics Authority indicated that during the period of January-June 2021, coconut oil exports from Philippines declined by 34% to 353,723 metric tons from 474,153 metric tons in January-June 2020 reflecting lower production of the oil in the country. The exports are expected to improve in the second half of 2021 following higher production and demand, especially from Europe and USA.

Meanwhile, export coconut oil from Indonesia is recorded a higher volume during the first half of 2021. During the period, Indonesia shipped 297,445 MT coconut oil to global market. The export was 4.8% higher as opposed to the previous year's volume. Indonesia has played complementary role in the global market as Philippines experienced a distraction in production. Major markets for Indonesian coconut oil were Malaysia, United States, China, and Netherlands. Export volume to these four countries constituted for more than 66% of the total export.

Global production of lauric oils is expected to improve in the last quarter of 2021 assuming good weather condition and controllable COVID pandemic especially in Southeast Asia. However, overall production in 2021 is projected only in a modest level. World production of the two lauric oils is estimated to recover by 0.2-0.3 million tons in 2020/2021. Production of both oils was still hindered by the lagged effects of previous dryness in Southeast Asia. Coconut oil output will take some

time to recover from last year's severe typhoon damage while labour shortage mainly in Malaysia hamper palm kernel output.

Despite the challenges, Philippines' coconut oil is anticipated to recover by 14% to 1.1 million tons (Oil World). Likewise, coconut production in Indonesia is projected to modestly improve following expected better weather condition. Higher yield in 2021 is also projected in India. Coconut Development Board of India estimated that coconut production will reach 21,487 million nuts or 2.46 million copra equivalent. Coconut Research Institute Sri Lanka forecasted that annual coconut production will increase by 19%. As a result, export of coconut oil for 2021 is projected to go up by 4% to 1.92 million MT in copra terms from estimated year ago total at 1.86 million MT. However, the modest increase in supply is projected to happen in the second half of 2021.

With a modest increase in supply, coconut oil price will remain strong in the second half of 2021. However, an expected increase in production of palm kernel oil in the coming years and looming increase of coconut oil supplies will put a price pressure for both lauric oils. Depending upon the magnitude of supply and price pressure, in the meantime it is expected a production surplus and a recovery of stocks of coconut oil.

[1] *Market and Statistics Officer, International Coconut Community*

	2019	2020	2021[P]
Philippines	1.82	1.51	1.57
Indonesia	1.32	1.30	1.34
Other countries	1.62	1.56	1.68
World	4.76	4.37	4.59

Source: Oil World p: projected figures

Table 4. Copra Production, 2019-2021 (million tons)

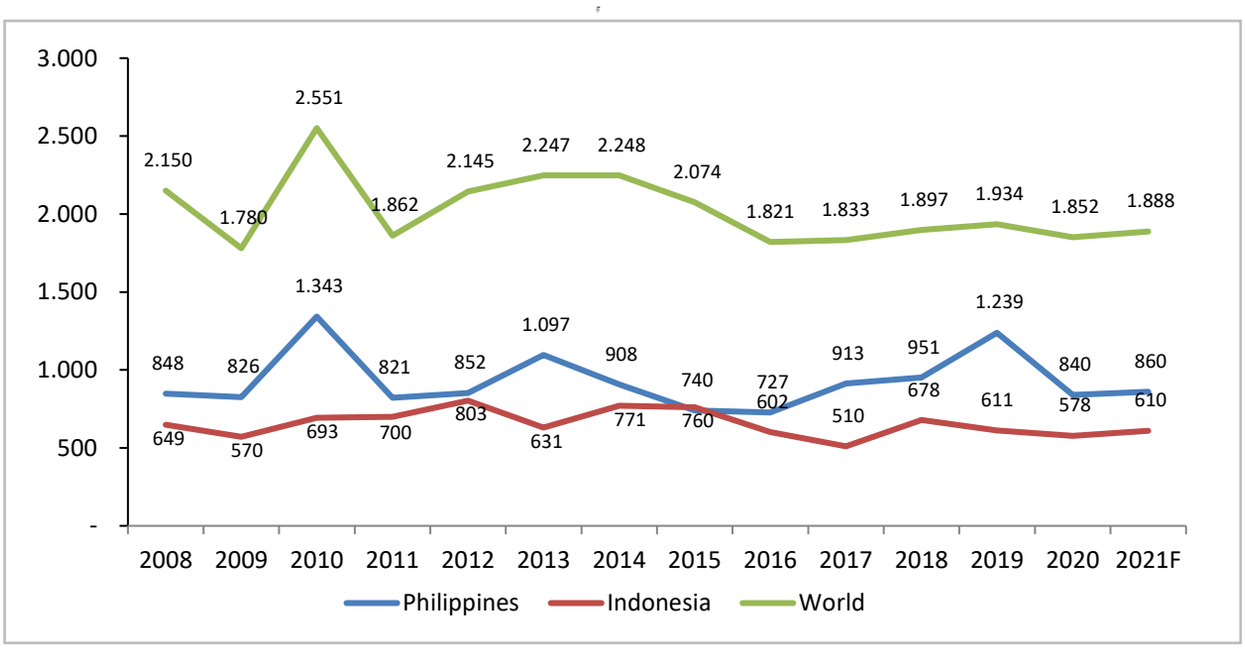

Figure 2. Exports of Coconut Oil from Philippines and Indonesia, 2008-2021

INTERNATIONAL WEBINAR ON COCONUT IN SMART AGRICULTURE

To celebrate its 60th Anniversary, the Faculty of Agriculture, Sam Ratulangi University, North Sulawesi, in collaboration with the International Coconut Community convened an international webinar with the theme "Coconut in Smart Agriculture" on 11th December 2020. More than 185 participants from the ICC member countries across the Globe attended.

Dr. Jelfina C. Alouw M. Sc. Ph.D., Executive Director, ICC, in her welcome speech, expressed her gratitude towards the Anniversary organizing committee for choosing coconut as the main topic of this webinar. She added that North Sulawesi Province, which is famously known as the "Province of Nyiur Melambai" (waving coconut trees), has prioritized coconut as the main program.

In his opening remarks, Prof. Dr. Ir. Grevo. S. Gerung, M.Sc., Vice Rector of Academic Affairs, Sam Ratulangi University, addressed that in North Sulawesi Province coconut has become the main crop, contributing 60% of the non-oil and gas sector. The university is ready to collaborate with any institutions at National and International level because knowledge is universal, belonging to all the institutions.

As keynote speaker, Dr. Jelfina C. Alouw M. Sc. Ph.D., Executive Director, ICC, presented "Global Scenario of Coconut Sector during COVID-19 Pandemic" which addressed the present situation: contribution of coconut and its products; coconut in smart agriculture, precision agriculture (or smart farming) can significantly boost the agriculture production both in terms of productivity and sustainability, global production, price and market/export of coconut and its various products.

Dr. Fabian M. Dayrit, Professor Emeritus, Ateneo de Manila University, Philippines, and Chairman, ICC Scientific Advisory Committee on Health, presented "The Coconut: Treasure of the Tropics", which covered three main issues: the coconut is the fruit of the tropics, the coconut as the tree of life and prosperity, and the Coconut against COVID-19, in which he explained the origin of coconut, history of coconut, coconut cultivation and derivative products as the tree of life and prosperity.

Mrs. Deepthi Nair S, Deputy Director, Coconut Development Board, Government of India, presented "Good Agriculture Practices in Coconut and Coconut Farmer Organizations in India". Sustainable agriculture must ensure social progress, economic growth, and environmental protection.

Dr. Nguyen Quang Thien, Ph.D., Coconut Biotechnology, School of Biotechnology, Vietnam National University presented "Coconut Cloning for Worldwide Replanting Urgency". He focused on the health-conscious lifestyle, increasing market demand for coconut products, which is the driving force to the urgency.

Prof. Jimmy Botella, the University of Queensland, Australia presented "Lethal Yellowing Disease in Coconuts: A Diagnostic Tool, and the Potential of Satellite-based Surveillance".

Dr. Joko Purbopuspito, Lecturer, Faculty Agriculture, Sam Ratulangi University, spoke on "Soil Management for Coconut Smart Agriculture" and mentioned that sustainable development is a development that meets the present needs of this generation without compromising the ability of future generations to meet their own needs.

In his closing remarks Prof. Ir. Robert Molenaar, MS, Ph. D., Dean of Faculty of Agriculture, addressed that Indonesia has the largest coconut plantation in the world, but the productivity is only a half of India. It is our challenge to increase the production. Smart technology is available to overcome problems in a smart way.

The webinar was moderated and chaired by Prof. Ir. Robert Molenaar, MS, Ph. D, Dean of Faculty of Agriculture, Unsrat and Dr. Johny Tasirin, Deputy Dean for Academic Affairs and Cooperation, Faculty of Agriculture, Sam Ratulangi University.

ICC CONDUCTED WORKSHOP ON COCONUT STATISTICS

ICC Secretariat had conducted the first coconut statistics workshop which was held virtually on 31 May 2021 for the middle-level officers from the ICC member countries responsible for agriculture statistics, especially in the coconut sector. The workshop aims to improve the capability of participants in identifying and applying feasible statistical methods in producing accurate coconut statistics, to establish a coconut statistical network among ICC member countries and collaborating partners, and to encourage member countries on timely reporting statistical data to ICC Secretariat. There were 41 participants from 16 ICC member countries.

Dr. Jelfina C. Alouw, Executive Director, ICC, delivered the opening remarks. She mentioned that Statistics is an important starting point in building a good network among ICC member countries. Statistics is also an important base in the policy-making process. Hence, statistical data should be accurate, timely, and reliable. She hoped that at the end of the workshop, the participants could understand the different statistical methods to collect the data effectively and efficiently and reported to ICC promptly. She requested all the participants to share their knowledge and experience to understand, adopt and adapt the methods and experience for the benefit of their countries and coconut sector.

The first speaker of the workshop was Ir. Sri Sayekti, M.Sc. trainer and facilitator from the Education and Training Center, BPS Statistics Indonesia. She presented "Data Collection Methods and Estimation on Agriculture Statistics". She was assisted by Dr. Edwin Tanur.

In the Knowledge Sharing session speakers from the Philippines; India and Sri Lanka shared the methods and agencies involved in the collection and implementation of Statistics data in their countries. Mr. Benjamin R. Madrigal, Jr., Administrator, Philippine Coconut Authority, presented "Philippine Coconut Statistics".

Mr. Vasanthakumar V.C, Statistical Officer, Coconut Development Board, India, shared "The Data Collection Methods & Estimation of Statistics of Coconut in India".

Dr. Sanathanie Ranashinghe, Director, Coconut Research Institute, Sri Lanka, shared the policy frame and institutional arrangement, key statistics coconut data information, data collection methods, cultivation and production data, local consumption, data on value-added products exports, and imports.

Mr. Alit Pirmansah, Market & Statistics Officer, ICC, demonstrated how to utilize the ICC's newly developed statistical webpage and online database in which the identified contact officer from the ICC member countries could upload their own countries' statistics data.

The queries raised by the participants were addressed by the speakers in the Q&A session.

The closing remarks were delivered by Mr. Benjamin Madrigal, Jr., Administrator, PCA. He expressed his gratitude to ICC for conducting this workshop which is the need of the hour. Activities like this truly underscore the crucial role of the ICC in harmonizing and gathering best practices in the industry development strategy for the benefit of its member countries.

The webinar was moderated by Ms. Mridula Kottekate, Assistant Director, ICC.

NEWS ROUND-UP

OBITUARY

Mrs. Sri Hartati, Finance Assistant of International Coconut Community (ICC) , Jakarta, Indonesia, passed away on 24th June 2021. Mrs. Sri Hartati has been working in the ICC since 1988. Mrs. Sri Hartati is survived by her husband, Mr. Much. Kabib and two sons: Mr. Astu Widodo and Mr. Iqbal.

International Coconut Community family deeply mourn the sudden and untimely death of Mrs. Sri Hartati.

COCONUT OIL IS NOT LINKED TO HEART DISEASE

In response to an article published in the Sunday Times, on October 25, 2020, the International Coconut Community, Jakarta, has submitted the following statement:

On behalf of coconut stakeholders in Sri Lanka and beyond, the International Coconut Community (ICC) strongly refutes claims aired in the Sunday Times article headlined *'Now coconut oil is bad for your heart'*, by Kumudini Hettiarachchi (the Sunday Times, Sri Lanka, October 25, 2020).

Ms. Hettiarachchi cites a research review paper: Jayawardena et al - *"Effect of coconut oil on cardio-metabolic risk: A systematic review and meta-analysis of interventional studies"*. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2020: Volume 14: 6; 20072020.

The ICC does not believe that the article has effectively 'sift[ed] fact from assumption'. The cited review is based on a meta-analysis, but Jayawardena et al's analysis mixes short-term and small studies with long-term and large studies and treats them as if they are of equal significance. He has committed the error of 'comparing apples and oranges'. Second, he makes conclusions based on questionable criteria, like LDL-C, while ignoring others which are well established, like HbA1c and triglyceride levels. Thirdly, the review raises questions about the selective bias and quality of the data used. Their analysis leads to a flawed conclusion. This paper is misleading for several reasons.

First, the conclusion focused exclusively on changes in LDL-C levels but ignored the more important point regarding whether the resulting LDL-C levels were unhealthy; they were not. In fact, the consumption of coconut oil did not result in unhealthy levels of LDL-C. In January 2020, Astrup and co-authors questioned the use of LDL-C as a link to heart disease. The concern with LDL-C is a theory that is not universally accepted and remains unproven.

Second, the Jayawardena study downplayed the beneficial changes in lipid parameters that were due to coconut oil. In particular, coconut oil raised HDL-C and gave a favourable ratio of total cholesterol to HDL-C. HDL-C, the so-called "good cholesterol" is associated with heart health. The article also acknowledged that coconut oil lowered the levels of HbA1c, the average level of blood sugar, and did not raise triglyceride levels. High triglycerides appear to be more strongly linked to heart disease than LDL-C. Why is the article discounting these beneficial effects of coconut oil?

In one statement, Prof. Jayawardena, stresses that "we have to understand the level of evidence. Systematic review and meta-analysis of randomised clinical trials (RCTs) are the ultimate evidence, although isolated small studies have different

conclusions". Systematic reviews and meta-analyses present results by combining and analysing data from different studies conducted on similar research topics. The high level of evidence produced by RCTs overrides the isolated evidence, he says. In their review, the team had examined over 1,000 research articles, selecting only 23 of the human clinical trials for inclusion in the analysis.

Of the few publications on coconut oil and cholesterol, there had been two local interventional dietary studies by Prof. Shanthi Mendis and co-workers from three decades ago. However, stressing that their results came from a systematic review and meta-analysis from findings of studies considered to be of the "highest quality evidence", he says there is no value in comparing the results of isolated evidence. We do not agree: putting aside such evidence is just a way of ignoring an inconvenient truth. In the same way, Prof. Jayawardena ignored a recent meta-analysis by Eyres (2016) on 8 clinical trials and 13 observational studies concluding that coconut-based diets are not linked to an increase in the risk of cardio-vascular disease (CVD).

The best way to counter such an argument is by using the same "highest-quality evidence", by providing other meta-analysis studies. In 2017 Lancet published a meta-analysis study involving a team of 37 researchers from 18 countries. They gathered data on 135,000 subjects to evaluate heart disease risk in relation to fat intake and found no correlation between saturated fat consumption and cardiovascular disease; they recommended that current dietary restriction on saturated fat should be revised.

In 2010, a groundbreaking study was published in the American Journal of Clinical Nutrition. This meta-analysis study combined the data from 21 previously published studies, involving over 347,000 subjects.

The study showed that there was no connection between saturated fat consumption and heart disease. Those people who ate the greatest amount of saturated fat were no more likely to suffer a heart attack or stroke than those who ate the least. No matter how much-saturated fat one ate, the incidence of heart disease was not affected. This was the most complete review of the medical research on saturated fat ever done up to this time.

Four years later, a different group of researchers from the University of Cambridge published another meta-analysis study. This time the researchers combined the data from 72 previously published studies involving more than 600,000 participants from 18 countries.

The results confirmed the previous meta-analysis there is no connection between saturated fat intake and heart disease. The studies are clear, neither saturated fat nor coconut oil causes or even promotes heart disease. Because they raise good HDL-C and lower the cholesterol ratio, if anything, they help to protect against heart disease.

The Jayawardena study committed the serious error of comparing populations from countries such as South Asian, Southeast Asian and Pacific island states (which consume coconut oil in their normal diet) with short-term studies conducted in Western countries that do not normally consume coconut oil. How could they use data from these small one to four-week studies done in the West to infer health outcomes in Asian countries and draw conclusions about the prevalence of CVD in South Asia? Jayawardena cited a long-term study but did not give it the significance that it deserved. Vijayakumar and co-workers (2016) reported their results of a study that involved 200 participants who used coconut oil or sunflower oil as cooking oil for two years. The study showed that coconut oil gave comparable LDL-C values compared to sunflower oil.

Clearly, a critical assessment of the Jayawardena paper and other supporting evidence show that coconut oil is not linked to heart disease. *(ICC News)*

ICC HOLD THE 2ND WEBINAR "HEALTH AND ECONOMIC BENEFITS OF VCO DURING COVID-19 AND BEYOND"

Webinar on **"Health and Economic Benefits of VCO during COVID-19 and Beyond"** was organized on 8th December 2020. This is in continuation of the agreement between the International Coconut Community (ICC) in collaboration with the Non-Aligned Movement Centre for

South-South Technical Cooperation (NAM-CSSTC) in providing cooperative services to the member countries in research and development programs, capacity-building, technology transfer, under the theme: **"Stay Healthy and Productive during Covid-19 Pandemic"**.

More than 75 people from the ICC and NAM-CSSTC member countries in Asia, Australia, the Pacific, and Africa took part in the webinar.

Dr. Jelfina C. Alouw, Executive Director, in her welcome speech, addressed that the pandemic has restricted our mobility, but at the same time has triggered us to find ways to stay productive and has enabled scientists and medical doctors to reveal the coconut oil as an adjuvant against COVID-19. All member countries and national bodies are encouraged to do more studies to reveal more excellent potential of coconut oil and other coconut-based products to improve the previous findings and get more benefits. The diversification of coconut-derived products and value-addition help the small and marginal farmers who depend on coconut for their livelihood to realize a better return.

VCO has gained its popularity during early 2000 because of lauric acid's antimicrobial properties, the major fatty acids in VCO. Coconut oil has been endorsed by the World Dental Association as an antibiotic against tooth decay. The antibacterial activity of coconut oil takes on a special significance today when the number of antibiotic-resistance bacteria is rapidly increasing. VCO has anti-inflammatory, skin-protective activities, effective therapy for Alzheimer's, and most recently as an adjuvant against COVID-19. She hoped that the participants also come forward to consume, promote, and set up a VCO processing unit in their area as the source of functional food for their families and they can sell them as a source of income. We look forward to a global economic recovery from COVID-19 and sustainable coconut development.

Dr. Atmarita, MPH. Ph, Member of Expert Team, Indonesian Nutrition Association, presented **"Health Benefits of VCO against COVID-19"**. She explained the composition, purity, and benefits of VCO. VCO had an antithrombotic effect, a significant beneficial impact on blood coagulation, which could help prevent cardiovascular diseases, has the same anti-inflammatory, analgesic, antipyretic, antioxidant, anti-stress, and antimicrobial properties.

Dr. Fabian M. Dayrit, Professor Emeritus, Ateneo de Manila University, Philippines, and Chairman, ICC Scientific Advisory Committee on Health, presented **"Clinical Trial on the Impact of VCO as Adjuvant Against COVID-19"**, the beneficial effects of Virgin Oil and its characteristics. Dr. Toby explained the mechanism, how the VCO fights against the COVID-19 virus through its antiviral, immunomodulatory, and anti-inflammatory activities. He also presented the results from clinical studies on COVID-19 cases, proved that VCO is an affordable, readily available, and healthy functional food. Still, it needs further R & D to study whether VCO is effective in protecting persons with comorbidities and can improve the efficacy of vaccines.

Mr. Annas Ahmad, Marketing Manager, Vico Bagoes, presented **"Manufacturing & Marketing with Economic Benefits of VCO"** which explained the production and marketing process of VCO. The VCO can be processed by both dry and wet processes (fermentation or centrifuge). There are some concerns from the production aspect: taste and aroma, quality, certification, and cost-benefit analysis. The VCO market is rising, accelerated by the back-to-nature lifestyle trend, COVID-19, new research findings, and social media. There are more than 100 new brands founded in the market now. VCO still needs more development and innovation. Digital marketing could increase market awareness and promote the benefits of coconut oil.

In his closing remarks, Ambassador Diar Nurbintoro, Acting Director, NAM CSSTC, mentioned that the collaboration between NAM-CSSTC and ICC webinar and online training program commenced from September 2020 has gained positive responses

from participants. The webinar has created a bridge that linked the agriculture and the health sectors. He hoped that the research on VCO against COVID-19 would inspire the coconut stakeholders to increase VCO production as a value-added product that will improve farmers' welfare, especially in the NAM-CSSTC and ICC member countries.

There was an in-depth discussion on the topics, and the speakers addressed the queries. The webinar was moderated by Mr. Vincent Johnson, Interim COGENT coordinator, ICC. *(ICC News)*

MALAI: A KERALA COMPANY IS MAKING LEATHER FROM COCONUT WATER

No animals were harmed in the making of this leather. Kerala's coconuts are being used to make a textured, water-resistant pleather, used in bags, pouches, wallets and shoes.

Behind the innovative material is a company called Malai — Hindi for Cream, and also a term used for the soft milky flesh of a fresh coconut. Malai was launched in 2018 by Zuzana Gombosova, a material researcher and fashion designer from Slovakia, and CS Susmith, a product designer from Kerala. Susmith has since moved on and Gombosova heads the company with a new business partner from Kerala named Aqeel Sait.

"I liked my job as a designer before Malai, but I was also fully aware of how much we fill our world with goods in the name of design," Gombosova says. "I wanted to create and develop methods and materials that didn't have such a negative impact on our environment. The idea with Malai is to create a vegan alternative to leather that is eco-friendly to make and dispose of."

The pleather is biodegradable and compostable. Its primary raw material is a kind of bacterial cellulose called Nata de Coco or coconut gel in the Philippines, where it is used widely in the food industry. Malai has tied up with farmers and processing units in Kerala to use the coconut water they have no use for.

This water from mature coconuts is fermented to create the cellulose. The cellulose is then enriched with fibres from hemp, sisal and banana stems and refined into sheets of grey material. The sheets are treated and, in some cases, dyed.

"I believe that in order to live sustainably one needs to do far more than just shop sustainably," says Gombosova, who has moved to Kochi to nurture the project. "But we do live in a very complex world where most of us cannot fully detach from the consumer world."

A healthy alternative, she believes, is slow living, and so Gombosova began research into sustainable, plant-based materials as part of her MA studies in the field of biomaterials. She drew inspiration from south Asia and the brand was born.

Malai now uses its material to make bags and shoes available on its website at prices ranging from Rs 1,800 to Rs 9,500. It also supplies the material to brands such as Riti in India, the UK-based Ethical Living and Lucky Nelly in Germany. And it's being pitched by the company for potential uses in furnishing and interior surfaces too.

"Malai looks and feels as good as leather but it doesn't have the cruelty that leather has," says Arati Krishna, founder of Riti. "We have made a host of accessories from it, including wallets and bags. And it makes me happy that it is made in India."

The Malai team is currently just 10 people, including labour, sales staff, interns and external consultants, but their work is being noticed already. In February, the brand won the Circular Design sustainability in fashion challenge during Lakme Fashion Week.

"The world has not got very far with R & D on biodegradable materials for, say, airplanes," Gombosova says, "but we can certainly use eco-friendly materials in the fashion, furniture and footwear industries." *(Hindustan Times)*

PHILIPPINES URGED TO EXPLORE COCONUT OIL AS THERAPEUTIC FOR COVID-19

The Philippines should not limit itself to vaccines in fighting the pandemic, but also tap the locally-available virgin coconut oil (VCO) as an effective therapy against Covid-19, an advocate of the substance said.

VCO Philippines president Marco Reyes suggested this amid the emergence of a mutation of the coronavirus, saying that the benefits of VCO have been proven in clinical studies by the Department of Science and Technology-Food and Nutrition Institute (DOST-FNRI).

Reyes, who is also vice chair of the United Coconut Associations of the Philippines, said VCO is an antiviral functional food not only against Covid-19, but also against the "broad spectrum" of viruses that afflicts humans.

"We already have medical evidence on its safety and efficacy.

"Vaccines are specific to the virus. When the virus mutates, the vaccine becomes ineffective, and new vaccines need to be developed," Reyes said in a statement.

Dr. Ed Lalusis, the patented inventor of VCO (Growrich) in capsule form, echoed the sentiment, urging the government task force leading the country's pandemic response to include the promotion of VCO as a preventive therapy.

"We're asking the government to include VCO as an additional regiment to prevent the spread of the virus.

"Anyway, this is already supported by DOST studies," said Lalusis, who is a retired general surgeon. *(New Straits Times)*

EXECUTIVE DIRECTOR OF ICC HAD A VIRTUAL COURTESY MEET WITH THE VICE-MINISTER FOR FOREIGN AFFAIRS OF THE REPUBLIC INDONESIA

With the objective to discuss potential cooperation and synergy between ICC and the Ministry of Foreign Affair of the Republic of Indonesia in international forum, and the joint working group between ASEAN and European union related to SDGs for vegetable oil, a virtual courtesy meeting between Dr. Jelfina C. Alouw, Executive Director, ICC and the Vice-Minister of Foreign Affairs of the Republic Indonesia, His Excellency Mr. Mahendra Siregar was held on 8 February 2021. Four directors of The Indonesian Ministry of Foreign Affairs also attended the meeting. Mr. Hari Prabowo, Director for Development, Economic and Environmental Affairs, Mr. Agustaviano Sofjan, Director for Trade, Commodity, and Intellectual Property; Ms. Carolina Tinangon, Director for ASEAN External Cooperation. The Non-Alignment Movement-Centre for South-South (NAM-CSSTC) was represented by Hon. Ambassador Mr. Diar Nurbintoro, Acting Director, and Ms. Niken Supraba, Assistant Director for Programme.

Dr. Jelfina C. Alouw presented ICC's vision and mission, local and global coconut scenario, coconut program and projects to support the sustainable development goals. She also presented the challenges confronting farmers and the coconut industry, strategies to promote the positive attributes of coconut, and counter unjustifiably negative campaigns. The strategies included partnership, research and development, publication, webinar, scientific discussion, and communication. One of the implementations of the strategies is the upcoming ICC and FAO meeting on "Coconut Oil: Saturated Fat, Animal Fat and Cardiovascular Disease" which will be held in the second week of March 2021".

In his opening remarks, His Excellency Mahendra Siregar, Vice Minister for Foreign Affairs, shared the background of the meeting. The meeting was in the context of the Joint Working Group between ASEAN and the European Union related to SDGs for vegetable oils, which including the palm oil commodity and other vegetable oil including coconut oil. The Foreign Minister has succeeded in convincing the involvement of Cambodia, Laos, Thailand & Vietnam to address the specific issue of coconut oil. It is in this perspective that the Ministry of Foreign Affairs held this meeting to get a perspective from coconut stakeholders represented by ICC on how to accommodate coconut sectors in the Joint Working Group.

Mr. Hari Prabowo, Director for Development, Economic and Environmental Affairs, Ministry of Foreign Affairs, shared Indonesia's diplomacy changes, from palm oil diplomacy to vegetable oil diplomacy. This is related to negative campaigns aimed at palm oil, coconut oil and

other commodities such as rubber, cocoa, coffee, which have always been linked to deforestation. In fact, the contribution of palm oil and coconut oil to achieving the SDGs is more significant than other vegetable oils. In a meeting with the FAO Intergovernmental Meeting on Oils Seeds, Oils and Fat, on March 4-5, 2021, Indonesia will propose that the ASEAN-UE Joint Working Group on Palm Oils should be expanded also to other vegetable oils, including coconut oil.

Ambassador Mr. Diar Nurbintoro, Acting Director, Non-Alignment Movement-Centre for South-South (NAM-CSSTC), expressed his commitment to more collaborative programs with the ICC always ready to work together and fully supporting in countering negative issues about coconut and providing support on coconut-related research and development.

There were in-depth and fruitful discussions on the further collaborative actions of the strategic implementation. In his closing remarks, His Excellency Mahendra Siregar, Vice-Ministry of Foreign Affairs expects synergy among ASEAN countries to counters the negative campaigns and provides his support to address challenges in the coconut sector, ICC's programs and projects and the Ministry of Foreign Affairs is ready to provide support in communicating at the ministerial level. *(ICC News)*

MEMORANDUM OF UNDERSTANDING BETWEEN INTERNATIONAL COCONUT COMMUNITY AND UNIVERSITY OF SAM RATULANGI, MANADO

Memorandum of Understanding executed between Dr. Jelfina C. Alouw, Executive Director, International Coconut Community, and Ms. Elen Joan Kumaat, Chancellor, University of Sam Ratulangi Manado, on Monday the 31st May during the 61st anniversary (dies natalis) of the Faculty of Agriculture of the Sam Ratulangi University.

The main objective and purpose of this MoU are to strengthen cooperation between the two parties in supporting the government on the establishment of a coconut development policy and the implementation of the program and to formalize effective linkages between the two parties for efficient transfer of technology and capacity building on various aspects of the coconut sector for mutual goals.

The scope of the Memorandum is to strengthen the institutional relationship between the parties to be able to engage in efforts to support a safe, inclusive, resilient, and sustainable coconut community; conduct research and development in areas of mutual interest; and strengthen capacity development and publication.

The Memorandum of Understanding was signed in the presence of Mr. Olly Dondokambey, Governor of the NorthSulawesi, faculties of the university, regents of North Minahasa, Central Minahasa, and South Minahasa, mayor of Tomohon city, and the invitees from the Ministry of Agriculture, Republic of Indonesia. The function was held in the auditorium of the university which was attended by more than 300 participants virtually and 100 participants physically. This is the beginning of the relationship between the ICC and the university and will collaborate for long-term cooperation for the welfare of the coconut farmers and industries in North Sulawesi, Indonesia, and can contribute to the development of the global coconut sector. *(ICC News)*

HOW COCONUT SHELLS CAN MAKE A PREMIUM CAR RIDE BETTER

Ingenious ideas come in many shapes and sizes, but when they do, it's often the result of applying some lateral thinking to something that's hiding in plain sight. So it was with Carbon Air, the British materials company, which saw an opportunity to improve the ride quality of air suspension using a material made from coconuts that can be used to enhance the performance of audio system loudspeakers. The material is activated carbon and, apart from coconut shells, it can be produced from other organic sources such as nutshells and wood.

Air springs work, as the name suggests, by using compressed air in a cylinder as a spring. The advantage is that they provide a smoother ride than steel coil springs, with added benefits such as being able to vary the ride height to improve aerodynamics, cover rough terrain and make access to the vehicle easier.

Air springs are extremely effective in premium cars but are still limited by the laws of physics. As the suspension deflects and the air in the spring becomes more compressed, the spring rate rises and the air spring becomes stiffer. A thumb over the end of a bicycle pump demonstrates how this works. Push the plunger in and it's easy at first, but near the end of the throw, more force is needed. Release some of the pressure with your thumb and the feeling of springiness comes back as the volume of air is reduced.

With an air spring, the greater the suspension movement, the stiffer the spring and the harder the ride. Letting air out of the spring isn't an option but there is a way of producing a similar effect and that's what Carbon Air's technology does. Activated carbon inside the air spring can adsorb (as opposed to absorb) air molecules as the pressure is increased, reducing the volume of air inside the spring. Because of that, the compliance of the spring is reduced as the suspension is compressed, giving a much smoother ride through the whole of the suspension travel.

Adsorbing means a layer of air molecules temporarily adheres to the surface of the activated carbon, rather than becoming soaked up by the material (absorbed). Under a microscope, activated carbon is a massive labyrinth of pores with a huge surface area for the gas molecules to be adsorbed on to. When this happens, the adsorbed air is effectively taken out of the equation as if it has been bled off from the air spring. Except it hasn't.

Carbon Air has patented the idea and licensed it non-exclusively to a major suspension manufacturer that supplies air suspension to Audi. Air suspension-equipped Audi A6s and A7s have it but the technology is also available for licence to any company that wants it.

Carbon Air technology is also being used in mountain bikes and motocross bikes. Talks are ongoing with audio manufacturers for shrinking large bass speakers and woofers without affecting the quality of the sound. *(Autocar India)*

CLINICAL TRIAL BY GADJAH MADA UNIVERSITY: VIRGIN COCONUT OIL AS ADJUVANT THERAPY FOR COVID-19 PATIENTS

Utilizing natural or herbal ingredients is now one of the efforts of researchers to find medicines supporting the treatment of Covid-19. Including using natural ingredients virgin coconut oil (VCO). Pulmonology Expert of Medicine Faculty, Gadjah Mada University (UGM) and Chairman of Airbone Disease Team of RSUP Dr. Sardjito, Dr. Ika Trisnawati said the pilot of VCO study as Covid-19 adjuvant therapy is currently taking place in 4 Yogyakarta hospitals, namely Dr. Sardjito Hospital, RSA UGM, Wonosari Hospital, and Sleman Hospital.

The use of VCO in Covid-19 therapy, is based on VCO content that has been known to have good anti-viral activities such as lauric acid (C12) and monolaurin (ML) and its derivates. "VCO is a medium chain fatty acids (MCA) containing lauric acid converted into monolaurin monoglycerides that have antiviral effects by destroying the lipid membranes of viruses," she explained in a webinar on Clinical Trials and Handling of Covid-19 organized by the Center for Herbal Medicine FKKMK UGM, as summarized from UGM website. VCO works just like soap, able to damage cell membranes in viruses. "When VCO enters the body will be converted into monolaurin which when interacting with the cell membrane of the virus and will damage the lipid layer in the cell. That way, the cell membrane of the virus becomes damaged and does not work," she said.

In a pilot study at 4 hospitals Ika revealed significant results ($p<0.05$) of the use of VCO in reducing TNF α in the VCO group compared to placebo. In addition, there was a decrease in inflammatory markers among other types of CR, ferritin, and IL6 although it was not statistically significant. Other findings showed a significant decrease in D Dimer and ferritin ($p<0.05$) both before and after intervention in the VCO group. Then, there was a decrease in CRP, IL6 and procalcitonin, but it was not significant. "VCO can reduce inflammatory markers in people with

Covid-19 so it is expected to prevent the disease worsening," she explained. *(Kompas)*

CHAIRMAN OF COMMISSION IV INDONESIAN HOUSE OF REPRESENTATIVE AGREES TO SUPPORT THE DEVELOPMENT OF INTERNATIONAL COCONUT GENEBANK IN MANADO

The Executive Director, ICC Dr. Jelfina C. Alouw visited the Head of Commission IV Indonesian House of Representative, Sudin, S.E. on 5th May 2021 to discuss the status of coconut development in Indonesia.

The meeting began with a brief introduction of ICC by Dr. Jelfina. She further added that Indonesia has been selected amongst one of the five host countries for hosting the International Coconut Genebanks (ICG). ICG is a center for embryo research and development to produce superior coconut varieties under the program of International Coconut Genetic Resources Network (COGENT).

ICG's location in Indonesia is currently located at Indonesian Palm Crops Research Institute (IPCRI) in Manado, North Sulawesi. Presently there are 51 superior coconut varieties that have been released and conserved by IPCRI and 111 varieties still in the development stage.

In order to improve the quality of coconut research and development in Indonesia, ICG needs its own site. The Executive Director of ICC said that they would build their own site for ICG in North Minahasa Regency, which is also in North Sulawesi. The Executive Director explained the benefits of having ICG in Indonesia, including the emergent requirement of superior coconut varieties and increasing demand of these varieties. ICG can also be a tourist destination so that it will improve the socio-economic welfare of the community there of that area.

However, this development plan facing some problem. The release of land for the purpose is getting delayed. Dr. Jelfina mentioned about this problem to Mr. Sudin, the Head of Commission IV Indonesian House of Representative. Mr. Sudin was very keen to know the prospectus of Indonesia becoming one of the center for coconut research and development at global level. Mr. Sudin expressed his support and assistance in the development of the ICG site and getting allotted the land for the purpose in North Sulawesi. According to Mr. Sudin, ICG development can open up opportunities for coconut development in Indonesia and has the potential to increase coconut exports so that it can improve the socio-economic development of coconut farmers in Indonesia.

Beside Jelfina, the meeting was attended by the Director of Indonesian Center for Estate Crops Research and Development Ir. Syafaruddin, Ph.D., as well as officers of Indonesian House of Representative, Dudi Gunadi and Mesa Kombe. As token of appreciation, Dr. Jelfina C. Alouw presented the ICC plaque and publications to Head of Commission IV of the DPR RI. *(ICC News)*

JAMAICA GOVERNMENT SEEKS PUBLIC-PRIVATE PARTNERSHIPS TO BOOST COCONUT PRODUCTION

The Government is looking to enter into suitable public-private partnerships to increase coconut production.

This was disclosed by Minister of Agriculture and Fisheries, Hon. Floyd Green, who informed that through the Coconut Industry Board (CIB), the Government is seeking to collaborate with private growers to boost the supply of coconuts for the industry.

"Under the partnership, the government are looking to produce 400,000 seedlings per year, which would be a 400 per cent increase, and to plant over 3,000 acres of coconut," Mr. Green said during his

Photo by: Michael Sloley from Jamaica Information Service

contribution to the 2021/22 Sectoral Debate in the House of Representatives.

He noted that the tremendous demand for coconuts and its by-products, such as coconut water and coconut oil is a clear opportunity for the country. He noted, for instance, that Grace Foods has indicated "that they could utilize 24,000 coconuts daily to satisfy their coconut water needs".

"Over the last year, we have expanded our nurseries at Barton Isles and Plantation Garden, we've distributed over 75,000 seedlings and planted over 100,000 seed nuts, but we need to accelerate this pace," he said, hence the need for the public-private partnership.

The CIB has responsibility for promoting the interest and efficiency of the coconut industry, encouraging the production of coconuts, regulating the purchase, sale and export of coconuts as well as the importation of coconut products and substitutes. *(Jamaica Information Service)*

Table 1. World Exports of Coconut Oil, 2016– 2021 (In MT)

COUNTRY	2016	2017	2018	2019	2020	2021[F]
A. ICC Countries	**1,548,733**	**1,610,131**	**1,829,073**	**1,929,105**	**1,714,559**	**1,768,742**
F.S. Micronesia	0	87	57	0	0	0
Fiji	1,779	1,955	3,261	2,487	2,533	1,860
India	29,215	11,726	6,985	7,632	11,096	12,500
Indonesia	602,318	510,352	675,270	650,000	578,048	610,000
Jamaica	7	6	5	6	0	2
Kenya	252	55	36	30	30	30
Kiribati	2,220	1,359	1,851	3,547	1,200	1,500
Malaysia	115,969	102,735	121,914	223,077	203,362	220,000
Marshall Islands	1,239	809	2,229	1,085	1,115	2,000
Papua New Guinea	23,866	26,565	22,341	21,047	31,556	28,000
Philippines	726,827	912,632	954,107	980,000	840,073	860,000
Samoa	546	1,098	32	50	50	50
Solomon Islands	1,487	5,515	5,670	4,221	5,408	3,000
Sri Lanka	22,679	20,126	19,039	16,400	21,335	15,000
Tonga	900	900	0	0	0	0
Thailand	1,236	1,331	1,266	1,337	1,745	1,600
Vanuatu	654	2,543	1,226	1,659	1,367	700
Vietnam	17,539	10,337	13,784	16,527	15,641	12,500
B. Other Countries	**327,780**	**167,349**	**124,151**	**112,600**	**118,000**	**119,000**
TOTAL	**1,876,513**	**1,777,480**	**1,953,224**	**2,041,705**	**1,832,559**	**1,887,742**

F: Forecasted figures *Source: ICC, ITC and Oil World*

Table 2. Prices of Coconut Products and Selected Vegetable Oils, July 2020-June 2021 (US $/MT)

	2020						2021					
Products	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Copra	592	600	632	665	848	920	936	884	934	916	960	967
Coconut Oil	886	954	1,034	1,105	1,380	1,459	1,463	1,433	1,542	1,542	1,684	1,631
Copra Meal[2]	231	205	206	209	259	281	248	211	199	208	246	262
Desicc. Coconut[2]	2,190	2,195	2,208	2,222	2,315	2,469	2,506	2,528	2,528	2,528	2,528	2,521
Mattress Fiber[1]	110	111	111	111	109	107	111	116	115	119	118	143
Shell Charcoal[2]	376	381	390	396	418	447	440	478	493	504	518	517
Palm Kernel Oil	684	739	768	806	1,073	1,225	1,372	1,343	1,482	1,482	1,530	1,419
Palm Oil	577	656	694	760	796	819	990	1,017	1,031	1,075	1,163	1,017
Soybean Oil	685	756	821	867	906	915	1,076	1,033	1,164	1,202	1,499	1,420

1: Sri Lanka (FOB); 2: Philippines (FOB) *Source: ICC and Oil World*

Table 3. World Oil Balance 2019-2021 (million Tons)

Oil/Year	Oct/Sep 18/19	Oct/Sep 19/20	Oct/Sep 2021[F]
Palm Oil			
Opening Stocks	14.61	14.93	12.44
Production	77.99	73.81	76.98
Imports	55.36	50.82	52.51
Exports	55.18	50.87	52.47
Disappear	77.84	76.24	76.98
Ending Stocks	12.49	12.44	14.93
Soybean Oil			
Opening Stocks	6.13	5.90	6.51
Production	56.66	58.38	60.17
Imports	11.88	12.71	12.85
Exports	12.09	12.87	12.67
Disappear	56.67	57.61	60.05
Ending Stocks	5.90	6.51	6.82
Groundnut Oil			
Opening Stocks	0.32	0.20	0.21
Production	4.01	4.14	4.31
Imports	0.31	0.33	0.46
Exports	0.34	0.32	0.48
Disappear	4.10	4.15	4.27
Ending Stocks	0.20	0.21	0.24
Sunflower Oil			
Opening Stocks	2.53	2.85	2.90
Production	20.06	21.54	16.68
Imports	11.64	13.57	10.88
Exports	11.83	13.70	10.79
Disappear	19.55	21.36	19.24
Ending Stocks	2.85	2.90	2.42
Rapeseed Oil			
Opening Stocks	3.40	3.01	3.12
Production	25.20	24.89	26.00
Imports	5.38	6.13	6.05
Exports	5.42	5.98	6.11
Disappear	25.56	24.92	25.77
Ending Stocks	3.01	3.12	3.29

Oil/Year	Oct/Sep 18/19	Oct/Sep 19/20	Oct/Sep 2021[F]
Cotton Oil			
Opening Stocks	0.37	0.29	0.29
Production	4.58	4.63	4.39
Imports	0.16	0.16	0.14
Exports	0.16	0.16	0.13
Disappear	4.66	4.62	4.41
Ending Stocks	0.29	0.29	0.27
Palm Kernel Oil			
Opening Stocks	1.15	1.41	1.37
Production	8.16	7.86	8.11
Imports	3.52	3.49	3.62
Exports	3.55	3.43	3.63
Disappear	7.87	7.96	8.19
Ending Stocks	1.41	1.37	1.28
Coconut Oil			
Opening Stocks	0.43	0.50	0.41
Production	2.95	2.69	2.71
Imports	2.11	1.93	1.91
Exports	2.17	1.94	1.88
Disappear	2.82	2.78	2.73
Ending Stocks	0.50	0.41	0.43

Source: ICC and Oil World *F: forecast figures*

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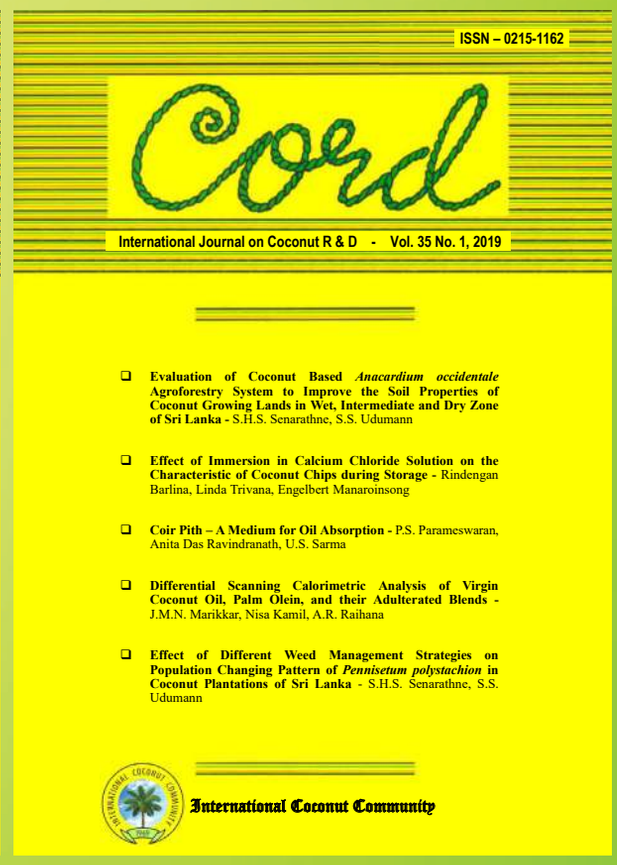

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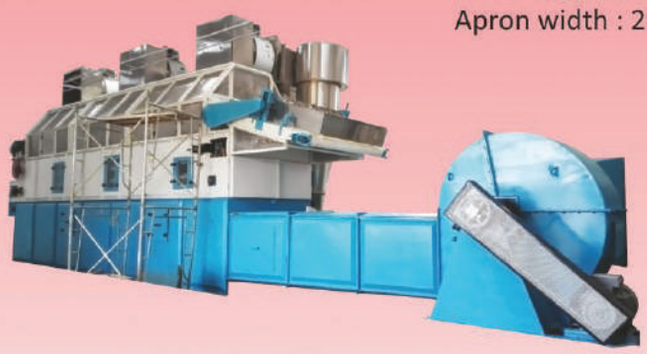

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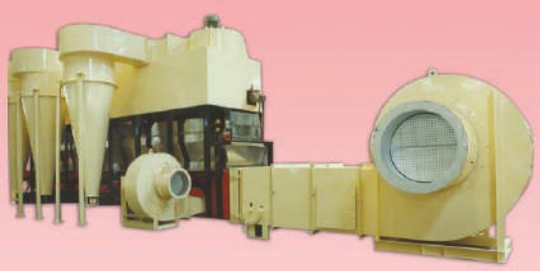

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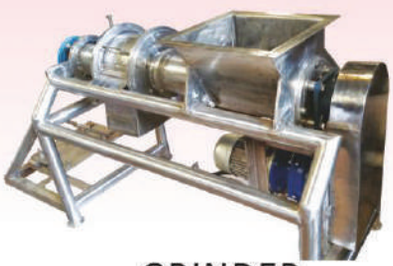

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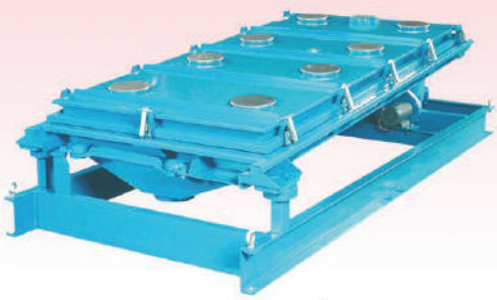

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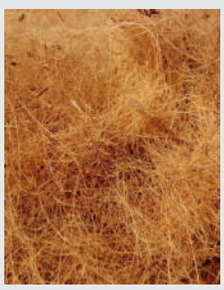

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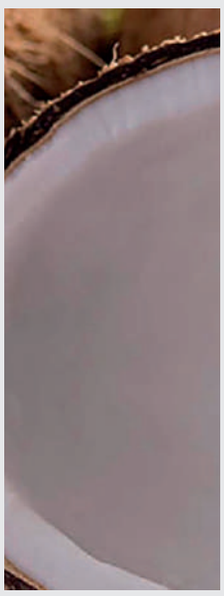

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