Technological options for the production of virgin coconut oil and defatted coconut kernel product

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Virgin coconut oil is the purest form of coconut oil, water white in color, contains natural Vitamin E and has not undergone any hydrolytic and atmospheric oxidation as attested by its very low free fatty acid content (even without refining) and low peroxide value. It has a fresh coconut scent which could be mild to intense depending on the process used.

Introduction

In India, the use of coconut for food and its applications in the Ayurvedic medicine have been documented in Sanskrit as early as 4000 years ago. However, it was only in the last thirty (30) years that people started to understand the secret behind the nutritional and health values of coconut kernel products as the work of scientist and medical researches particularly on coconut oil began to be published and presented in international seminars and fora . Notable among these studies is the pioneering work done by the medical researchers from the Michigan State University headed by Prof. Emeritus of Pharmacology, John J. Kabara who found out that the lipids (medical term for fat) in mother's milk which is giving babies immunity from diseases is very similar in structure to the medium chain fatty acids (MCFA) which is predominantly present in coconut oil and have similar nutriceutical effect. This finding triggered the conduct of a series of studies that led to the discovery of the anti- microbial properties of MCFA in coconut oil with lauric fatty acid and its monoglyceride form monolaurin as the most potent. The increasing number of published books, literatures, results of medical researches and internet information extolling the beneficial effects of coconut oil to the human body led to the development of a "niche" and very high value market for a special type of coconut oil which is processed differently from the traditionally known refined, bleached and deodorized (RBD) coconut oil. From a much maligned substance in the 80's which has been claimed by American Soybean Association as causing heart disease and atherosclerosis, this high quality version of coconut oil which is now generally referred to as virgin coconut oil has resurrected its reputation and made a dramatic turn-around in the world market as a functional food that not only nourishes but also heals. Dubbed as the " healthiest oil on earth" by Dr. Bruce Fife, a certified American nutritionist and author of the "Healing Miracles of Coconut Oil" and other books on coconut, virgin coconut oil (VCO) is obtained from the fresh and mature kernel of coconut by mechanical or natural

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means with or without the application of heat which does not lead to alteration of the oil and its properties. Virgin coconut oil is suitable for human consumption in its natural state immediately after extraction and filtration.

It is the purest form of coconut oil, water white in color, contains natural Vitamin E and has not undergone any hydrolytic and atmospheric oxidation as attested by its very low free fatty acid content (even without refining) and low peroxide value. It has a fresh coconut scent which could be mild to intense depending on the process used. VCO greatly differs from the traditionally produced copra derived coconut oil which has to undergo chemical refining, bleaching and deodorization processes to make it suitable for human consumption. RBD (refined, bleached and deodorized) coconut oil is yellow in color, odorless and tasteless and does not contain natural Vitamin E since this is removed when the oil is subjected to high temperature and the various chemical processes.

In processing VCO, two types of defatted coconut kernel products, low fat desiccated coconut and coconut flour can be produced as co-products depending on the type of VCO process that is employed. These two products are also classified under the high value coconut product category. Coconut flour is now also being marketed as a functional food in as much as studies have shown that it has high dietary fiber content that aids in lowering cholesterol and provides other health benefits to the human body. The dietary fiber content of coconut flour and low fat DC is much higher than oatmeal and flax seed that Americans are promoting as a healthy food.

Coconut flour is the ground solid residue/flakes obtained after immediate extraction of oil from dried comminuted coconut meat or coconut milk residue that is processed under sanitary conditions. There are three types of flour that can be produced from the coconut kernel as co-product of VCO processing. These are:

a. Full protein, medium fat coconut flour with testa

b. Full protein, medium fat coconut flour without testa

c. Low fat, high fiber coconut residue flour

Full protein, medium fat coconut flour with and without testa (items a & b above) are processed from fresh coconut meat. This flour contains all the proteins, nutrients and sugar that are present in fresh coconut meat including dietary fiber. Low fat high fiber coconut residue flour (item c) is processed from residue or "sapal" which is obtained after the extraction of coconut milk from comminuted fresh coconut meat. This type of flour has a lower protein content but with higher dietary fiber. Based on pilot studies done by Bawalan (2000), operating conditions for the production of coconut residue flour is different from the coconut flour obtained by directly processing fresh coconut meat.

On the other hand, low fat desiccated coconut is actually coconut milk residue which is dried under sanitary condition. Its protein, fat and sugar content are much lower than the traditionally known full fat desiccated coconut. However, its selling value is based on its high dietary fiber content. It should be noted that producers of full fat desiccated coconut are protesting on the use of the term " low fat desiccated coconut" to the dried coconut milk residue but so far, no official pronouncements has been issued yet on this issue.

The fast developing "niche" and high value market for VCO as nutraceutical substance or food supplement, as a body moisturizer, as hair conditioners and other applications offer an opportunity for small coconut farmers to further increase his income in as much as VCO can be produced on a micro scale operation using only simple equipment and tools. It has also been generating a lot of interest among businessmen and entrepreneurs to look into the different processes for producing VCO with the goal of having it as a possible source of livelihood and income. This paper will discuss the different technologies for producing virgin coconut oil, coconut flour and low fat desiccated coconut including the critical control points that have to be considered to insure the production of good quality VCO.

VCO Production Process

VCO can be produced either from the fresh comminuted coconut meat/kernel or coconut milk or coconut milk residue. This is schematically shown in Figure 1 which also shows that which processes will have coconut flour as a co-product. The choice of the technology to be adopted greatly depends on the scale of operation, the degree of mechanization that is

desired, the amount of investment available and most of all on the demand of the prospective buyer. VCO produced from each process exhibits different organoleptic characteristics such that the process used in producing VCO can be identified by sensory evaluation.

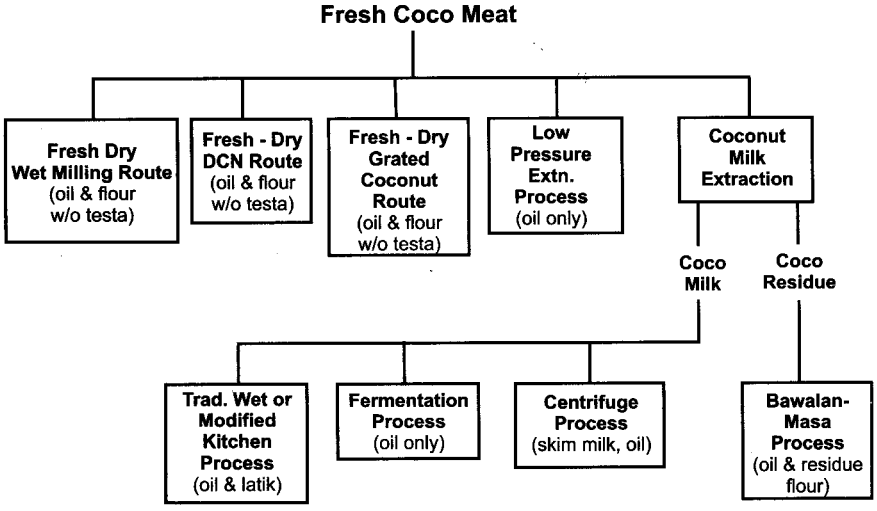

Fig. 1. Schematic diagram for producing VCO and coconut flour

Production Processes from Coconut Meat

Fresh Dry Process, Wet Milling Route. This process involves de-shelling the meat either manually or by de-shelling machine, splitting and slicing the de-shelled meat, washing, grinding or wet milling, drying the particulated coconut meat and then extracting the oil using a specially designed screw type press to produce virgin coconut oil and food grade full protein, medium fat coconut flakes. The flakes are further grinded to produce coconut flour with testa.

Fresh-Dry Process, Desiccated Coconut (DCN) Route. This process involves undergoing all processes necessary for the production of desiccated coconut (deshelling, paring, washing, grinding, blanching and drying) except sulfite treatment and then extracting the oil using a specially designed screw type press to produce virgin coconut oil and food grade full protein, medium fat coconut flakes. The flakes are further grinded to produce coconut flour. Desiccated coconut products which did not pass the quality standards for color and microbial content can be further processed to produce virgin coconut oil and aflatoxin free coconut flakes for animal feeds. This process is particularly useful to desiccated coconut processors wherein DCN which did not pass the stringent quality standard for the product can still be converted into high value virgin coconut oil and coconut flour or aflatoxin-free high grade animal feed.

Fresh-Dry Process, Grated Coconut Route. This process involves splitting the nut, grating, blanching and drying the coconut meat and then extracting the oil using a specially designed screw type press to produce virgin coconut oil and food grade full protein, medium fat coconut flakes. The flakes can be further grinded to produce coconut flour. It should be noted that this is similar to the DCN Route except that this requires fewer process step and equipment.

It should be noted that in the different routes/version of the fresh-dry process, the basic difference is just in the preparation of the fresh coconut meat before drying. After drying, they all follow the same extraction process using the same operating conditions as well as the post processing of the oil and resulting coconut flakes.

Low Pressure Oil Extraction or Intermediate Moisture Content Method. This process involves splitting the nut, grating the meat to fine particles, drying it to a moisture content of about 10 – 12 % and extracting the oil using a manually operated bridge press. In as much as it takes a lot of skills, exposure and training to manually determine if the dried grated coconut has reached 10–12 % moisture content, a practical way of doing it is to dry a portion of the coconut meat to bone dry state and then mix freshly grated coconut meat at a specific proportion to get the right moisture content. The Direct Micro Expelling (DME) Process developed by Dr. Dan Etherington which is being used in South Pacific also works on the same principle except that it differs in the type of manually operated press being used for oil extraction and the manner by which grated coconut is dried.

Production Processes from Coconut Milk

Before starting with any process to recover VCO from coconut milk, a pre-processing of nuts is required

for the extraction of coconut milk. This involves splitting the nut, grating the meat to fine particles, extracting the coconut milk with or without addition of water depending on the manner by which the extraction is done, either manual or the use of manually operated milk press (hydraulic or vertical screw type) or motorized screw type milk extractor. The type of coconut milk extraction method or equipment to be adopted is dependent on the scale of operation. Likewise, the number of milk extraction done and the type of hydrating liquid to be used (tap or purified water or coconut water) depends on the preference of the processor and the type of equipment used for milk extraction.

Traditional Wet Process/ Modified Kitchen Method. This method involves gradually heating the coconut milk mixture (1st and 2nd extract) until all the water has been evaporated to produce the virgin coconut oil and proteinaceous residue or "latik". One variation of the traditional wet process is allowing the milk to stand for 3 hours, then removing the coco skim milk (watery portion) that settles at the bottom and gradually heating the resulting cream to recover the oil. In this manner, process time to recover the oil is greatly reduced. The latik obtained from the modified kitchen method can be eaten as is or added to rice cakes or can be used as meat extender. However, if the settling time exceeded 3 hours, the latik already tastes sour and no longer palatable.

Modified Natural Fermentation Process. This process involves allowing the milk to stand for 16 – 24 hours depending on the ambient condition in the area. Then the fermented coco skim milk (watery portion) is decanted , the oil that separated out is filtered and the fermented curd which still contains part of the oil is gradually heated to further recover some oil. Fermentation is generally done using a transparent plastic container to see clearly the separation of the layers. Generally, 5 layers in a fermenting container can be seen. The first layer in the bottom comprises of solid gummy materials. The second layer is the watery phase which essentially is fermented coco skim milk . In terms of relative volume, this is the biggest . The third layer is the solid fermented curd which still entrained some oil. The fourth layer (second layer from the top) is the separated white coconut oil (main product). The fifth layer from the bottom or top layer is another solid fermented curd with some entrained oil.

Centrifuge Process. This process involves subjecting the coconut milk through a mechanical phase separation process through the use of centrifuge. Two types of centrifuge are generally used, the two phase (liquid-liquid) and the three phase (liquid-liquid-solid) centrifuges. The process which used a two phase centrifuge is considered as a two stage centrifuge process while the one which uses a three phase centrifuge is considered as a one stage centrifuge process. In the two stage centrifuge method, coco skim milk (watery phase) with the gums is separated first from the cream (oily phase). The resulting cream after the skim milk was separated is then subjected to vacuum evaporation, pass through a centrifuge again and filtered to obtain the VCO. On the other hand, in the one stage centrifuge method, coconut milk is fed together with hot water in the centrifuge wherein VCO is separated through high-speed low-turbulence centrifugation. The VCO is then filtered to remove adhering proteinaceous residue and passed through a vacuum dryer. Centrifuge process is done under a medium to large scale plant operation in as much as investment costs for the centrifuge equipment is very high.

Another version of the centrifuge process which was reported in the APCC Cocoinfo International and being used by a producer in Sulawesi involves blast freezing the coconut milk to a temperature of -5 ^{0}C, crushing the solidified milk and passing the liquefied crushed milk through the centrifuge to separate the water from the oil. The recovered oil is then subjected to vacuum drying. Compared to the centrifuge process described above, this version is much more energy intensive because a lot of energy is used in doing the blast freezing and subsequent crushing of the frozen coconut milk.

Production Process from Coconut Milk Residue

Coconut residue is a by-product of the coconut milk, nata de coco and coconut jam production process. It is also a by-product of the VCO production processes which are based on coconut milk. It represents approximately 25- 50 % of the weight of freshly grated meat on a wet basis depending on the coconut milk extraction process that is used. It still retains about 35 - 40 % of the original oil content of the fresh coconut meat. It has a low market value and is normally sold as animal feed. In some cases, it is just being

thrown away. There is still a question whether the white coconut oil obtained from coconut milk residue can still be qualified to the label "virgin". It is the opinion of the author that the oil obtained from the coconut milk residue is still entitled to the label "virgin" because it satisfies all the criteria attributed to a virgin oil. In terms of quality, it also more than passes the Philippine National Standard for VCO.

Bawalan - Masa Process. The production process was developed by the author while holding the position of former Senior Science Research Specialist, Product Development Department (PDD), Philippine Coconut Authority (PCA) together with Ms. Dina B. Masa, Manager, PDD - PCA using the coconut milk residue from a coconut milk manufacturing plant as starting material. It involves blanching the residue, drying at a specific moisture content level and subsequently defatting the residue under controlled conditions using a specially designed equipment to produce virgin coconut oil and low fat, high fiber coconut flakes. The flakes are further grinded to produce coconut residue flour. The technology was adopted for commercialization on April 1st, 2002 by Sirawan Foods Corporation through a technology transfer agreement with PCA. It won second prize in the Most Outstanding Creative Research (Likha Award) category during the 1998 National Inventors Week and has an approved patent issued by the Philippine Intellectual Property Office.

Comparative analysis of different processes for producing virgin coconut oil

Type of Process	Quality of Oil and Recovery	Advantages and Limitations
1. Fresh – Dry Process (Wet Milling Route)	FFA - 0.05 – 0.08 % M.C - 0.07 - 0.1 % Color - water clear Oil recovery - 600 kgs per ton (1000 kgs) of dried milled coconut meat	• With the use of proper equipment, has the highest oil extraction efficiency among the VCO processes available. • Produces full protein, medium fat coconut flour as a co-product • Long shelf-life of oil – 1 yr and above • Uses mechanical type of equipment to produce the oil • Can be produced under small to medium scale plant operation
2. Fresh – Dry Process (Dessicated Coconut Route)	FFA - 0.05 – 0.08 % M.C - 0.07 - 0.1 % Color - water clear Oil recovery - 580 kgs per ton (1000 kgs) of desiccated coconut	• Produces full protein, medium fat coconut flour without testa as a co-product • Long shelf-life of oil – 1 yr and above • Uses mechanical type of equipment to produce the oil • High investment cost, medium scale plant operation
3. Fresh – Dry Process (Grated Coconut Route)	FFA - 0.05 - 0.08 % Moisture – 0.07 -0.1 % Color - water white Oil recovery - 300 kgs per ton of fresh grated meat	• Produces full protein, medium fat coconut flour without testa as a co-product • Long shelf-life of oil – 1 yr and above • Uses mechanical type of equipment to produce the oil • Can be done under small scale plant operation
4. Low Pressure Method	FFA - 0.1 - 0.2 % Moisture – 0.17 % and below* Color - water clear Oil recovery - 25 kgs per 100 kgs of grated coconut meat ** Moisture content of final product is highly dependent on the skill of the operator doing the drying process and preparing the grated meat prior to extraction.*	• Uses manually operated equipment to produce the oil • Produces a semi-dry coconut residue that has to be further dried or processed to have market value. • Shelf – life of oil can be very short if milled or grated coconut meat is not properly prepared prior to oil extraction. *Moisture removal in oil is recommended to ensure longer shlef life*

5. Traditional Wet or Modified Kitchen Process	FFA - 0.06 – 0.2 Moisture – 0.07 – 0.14 Color - water clear to pale yellow depending on the heating process Oil recovery - 16.5 kgs per 100 kgs of grated coconut meat	• Very low investment cost. • Can be produced on a home scale operation using ordinary kitchen utensils. • Produces a wet coconut residue that has to be further dried or processed to have market value. • Produces a by-product (proteinaceous residue) which does not have commercial value at present. • Oil gets rancid after 5 days if oil is not properly heated to dryness.
6. Modified Natural Fermentation Process	FFA - 0. 1- 0.2 % M.C.–0.12 % & below Color - water clear Oil recovery - 34 liters per 100 liters of coconut milk *(about 19 kgs oil per 100 kgs of grated meat)*	• Can be produced on a home scale operation using ordinary kitchen utensils or on small-medium scale operation using semi-mechanized equipment. • Disposal of fermented skim milk could be a big problem if done on medium scale plant operation. • Oil produced has a faint sour smell which can be removed by a proper post processing.
7. Centrifuge Process	FFA - 0.04 – 0.08 % Moisture – 0.1 % and below Color – water clear Oil recovery – about 28 liters oil per 100 liters of coconut milk	• Produces the best quality coconut oil with sweet coconut aroma if done in a two stage centrifuge process. • Can only be applied in a medium scale operation as investment cost is very high. • Optimization of the process is still required to improve oil recovery rate. Current oil recovery rates are much lower than the modified fermentation process. • Further processing of the coco skim milk into health beverage and the sapal generated into coconut flour can improve profitability
8. Bawalan –Masa Process	FFA - 0.05 –0.08 % Moisture – 0.07 – 0.12 % Color - water clear Oil recovery - 170 kgs per ton (1000 kgs) of wet residue	• Further recovery of high value oil from residue makes coconut milk processing more profitable. • Long shelf-life of oil – 1 year and above. • Produces low fat high fiber coconut flour as a by-product • Requires mechanical type of equipment to produce the oil·Production process has to be attached or integrated to an existing coconut milk processing plant

Among the VCO processing technologies, the natural fermentation method has the least labor requirement and the least energy input. However, if fermentation process is not properly controlled, then it produces VCO with a sour smell and relatively higher free fatty acid content. Precise control on the maturity of the coconuts and the ambient conditions in the fermentation area is necessary to obtain good oil recovery. On the other hand, the modified kitchen method produces VCO with an intense coconut aroma or scent. However, it has very low oil recovery in as much as a lot of oil remains entrained in the proteinaceous residue or "latik". In addition, it requires precise temperature control and timing during the heating process to prevent the oil from turning yellow. The highest oil recovery can be obtained from the fresh-dry process wet milling route but this could be applied only for small to medium scale operation because of the need to invest in a conveyor type dryer and an expeller with a built-in cooling system. On the other hand, the fresh-dry process (desiccated coconut route) provides an option to DCN producers to convert their off grade DCN into another high value product, VCO instead of wasting it. The VCO obtained from the centrifuge process has the best sensory attributes. It has the best taste and smells like newly opened fresh coconut. However, in terms of oil recovery based from fresh coconut kernel, the centrifuge process has the lowest.

Critical Control Points to Consider in VCO Processing

Coconut Selection

Maturity of coconut is a very important factor in the quality and recovery of VCO especially in processes involving the coconut milk route. Based on results of

studies done, coconut kernel from fully mature coconuts (12 – 13 months old) has the highest oil content and a relatively lower protein content as compared to the kernel from younger nuts (9 – 11 months old). It should be noted that coconut milk is an emulsion of oil and water stabilized by protein. To release the oil from coconut milk, the protein bond has to be broken so more oil can be recovered if the kernel from which the coconut milk is obtained has high oil content and lower protein content. As an indicator of maturity of the nut, the husk and shell is brown in color and gives sloshing sound when shaken. Always ensure that the nut while fully mature does not have "tubo" or haustorium. This is because the oil content of the kernel started to decline once the haustorium is formed. Aside from yield, the oil quality also deteriorates as the haustorium grows bigger.

Handling of Coconut Water

Coconut water spoils/ferments very fast once the nut is opened. As you split the nut, collect the coconut water in a container and dispose properly. Part of the coconut water generated can also be converted into vinegar as another source of income. Spilled coconut water on the floor if not immediately cleaned will invite flies in the area and become a source of contamination. It will also destroy the cement surface of the floor since fermented coconut water becomes very acidic. It also generates foul smell once fermentation started.

Sanitation and Handling of Equipment

Coconut meat/kernel and coconut milk are low acid food so they are very susceptible to microbial contamination. Because of this, strict sanitation in the plant area, personnel and equipment should be practiced at all times. Food grade stainless steel is the recommended material of construction for all parts of VCO process equipment that will come in contact with coconut kernel or milk. Listed below are some sanitation pointers that should be practiced.

a. Be sure that the blades of your grater including the housing is thoroughly cleaned with soap and water. Use hot water in the final rinse to prevent bacterial contamination. Cleaning of the equipment after use is a must.

b. Ensure that all materials, utensils or equipment that will be used in extracting and holding coconut milk are thoroughly cleaned and rinsed. It should be free from any soap residues.

c. Always ensure that grating of kernel and subsequent coconut milk extraction is done under sanitary conditions by observing personal hygiene especially washing hands with soap and water before doing any preparation work, cleaning all utensils to be used and keeping the work area clean.

d. Water to be used as diluent or rehydrating agent should be of high quality, free from microbial contamination and from too much mineral content. Purified or demineralized water should preferably be used.

Handling of VCO Product

Presence of water in oil will make its shelf-life short i.e. water in oil will cause rancidity upon storage. Ensure that the water content of the oil is down to 0.1% and that any process container or packaging material to be used for VCO are thoroughly dried and clean.

Value Addition Potential in VCO Processing

The fast developing and high value niche market for virgin coconut oil offers a good prospect for the improvement of the life of the farmer. In as much as virgin coconut oil can also be produced on a home, micro and village scale of operation, it creates a situation where coconut farmers can directly participate and get a bigger share of the profit of the industry instead of being a mere producer of copra.

Generally, coconut meat from 15 fully mature coconuts is required to produce 1 liter VCO if done on a home or micro scale of operation. Fifteen coconuts is roughly equivalent to 3.3 kgs of copra. Using the average domestic price of copra for 5 years (2004 – 2008) in the Philippines at Php 23.53 (US $ 0.49) per kilo, 3.3 kgs of copra from 15 coconuts will generate an income of US $ 1.62. On the other hand, if the 15 coconuts will be processed into VCO instead of copra, it will provide an income of Php 130.00 (about US $ 2.71) which is the bulk buying price per liter of VCO traders in the Philippines. The income obtained will even be higher if the VCO will be locally sold on retail. It was also observed that in areas where there are producers of VCO, the price per nut has increased already from Php 5.00 (US $ 0.10) to Php7.00 (US $ 0.15) which is also beneficial to farmers. It should be noted that

prices of copra for the last 2 years (2007-2008) are abnormally high compared to the historical average price of Php 10.70 (US $0.22) per kilo. There are also instances when the price of copra is going down to very low levels such that it is no longer viable for farmers to harvest and process their nuts. Under this condition, processing of coconut into VCO instead of copra is a much better option.

On the macro-economic level, the value addition in terms of foreign exchange earnings of the Philippines on the export of coconut oil is also very high. The average international price for copra derived coconut oil (1997 – 2008) is US $ 601/ MT (PCA Statistics) while the average export price for VCO (2004 – 2008) is US $ 3,086/MT (PCA Statistics). This means a value addition of about 500 %. With the said export price, VCO is now the highest valued coconut product in the world market.

Investment Requirement

The investment requirement in VCO processing greatly depends on the scale of operation and the degree of mechanization that one wishes to have. The cost of equipment for VCO processing is more expensive than the traditional oil extraction process based on copra because the use of food grade stainless steel as material of construction is a basic requirement. However, the advantage of processing VCO is that it can also be produced under a home scale operation using ordinary kitchen utensil and manually operated equipment. On a worst case scenario, extraction of coconut milk can even be done by hand. Shown in the table below are estimated total basic equipment cost for selected processes at specified scale of operation as of October 2005.

Type of Process	Capacity 8 hour day	Saleable Products	Basic Equipment Cost (US $)
1. Fresh Dry Process Wet Milling Route (Manual Deshelling)	2000 nuts/day	VCO Cocomeal Flakes	38,000
2. Fresh Dry Process Grated Nut Route	2000 nuts/day	VCO Cocomeal Flakes	35,000
3. Low Pressure Extraction Method	500 nuts/day	VCO Dried Cocomeal	3,600
4. Modified Kitchen Method	500 nuts/day	VCO Dried Coconut Milk Residue	3,600
5. Modified Natural Fermentation Method	500 nuts/day	VCO Dried Coconut Milk Residue	3,600
6. Bawalan-Masa Process	1,000 – 2,000 kgs wet coconut milk residue per day	VCO Coconut Flour	40,000*

*Cited equipment cost is in addition to the cost of equipment for coconut milk extraction and steam boiler

Market Potential of Processing VCO and Emerging Uses

At present, there is no statistics available yet on the actual world supply and demand scenario for VCO although there are a lot of talks about a big demand for the product. How big really is this demand in quantifiable terms is not yet known.

However, Philippine VCO market profile is showing that there is a big potential for VCO processing based on the following indications:

a. From a single Philippine VCO trader-exporter in 2001, the number increased to 65 registered VCO producers and 19 exporters as of the end of the first quarter of 2005. It should be noted however that as of March 2009, PCA reported that there are now only 39 VCO producers-traders-exporters. This is caused by the entry of big coconut processing plants in the VCO market which have the quality management systems in place and can afford to get organic certification that foreign buyers and domestic institutional buyers prefer. A lot of small scale producers stopped operation as market competition became very stiff.

b. Philippine production of VCO grew from a mere 1.8 MT in 2001 when VCO was first introduced in the world market to 3,009.11 MT as of the end of December 2004. Unfortunately, VCO production data from the Philippines from 2005 onwards were not available as only export data is being monitored regularly.

c. Existing big manufacturers of coconut products (desiccated coconut, coconut milk/cream) in the Philippines already included VCO in their product lines.

In addition, the internet abounds with increasing number of companies promoting and selling VCO.

In the Philippines, the domestic market for VCO is much bigger than the export market. While in 2001 and 2002, all VCO produced are exported, a different scenario was seen for 2003 and 2004. It should be noted that it was in May 2003 former Secretary of Health Manuel Dayrit announced in the media that "virgin coconut oil is more potent than Vitamin C in boosting the body's immunity against SARS". In 2003, out of the total production of 831.84 MT, only 113 MT or 13.58 % was exported. Likewise, in 2004, out of the total production of 3,009.11 MT, only 176.60 MT or about 6 % was exported. This shows a very strong domestic market. However, the export market has also moved up considerably. Export of VCO grew from a mere 1.8 MT in 2001 to 1,853.9 MT in 2007. VCO is currently being exported in 42 countries with the United States and Canada as the top two buyers. Most producers prefer to sell in the domestic market rather than the export market because of higher prices. Recorded Philippine export price of VCO (FOB basis) has tapered to about US $ 3.26 per kg (US $ 3.55 / liter) in 2008 from a high US $ 11/kg in 2001. Domestic equivalent retail price for VCO ranges from US $ 9.00 – 14.00 / liter when sold in 250 & 500 ml bottles. Aside from a big chain of drugstore with branches all over the country, VCO can now be bought in major supermarkets in Metro Manila and other big cities. Likewise, a big herbal supplement company, ABS Corporation and a big cosmetic company, Splash Corporation have already included VCO and VCO based products in their product line.

Emerging Uses of VCO

Virgin coconut oil can also be utilized in all applications where crude, cochin and refined, bleached and deodorized (RBD) coconut oil are normally used and would be a much better alternative if it can be made available in large volumes at affordable price.

In the manufacture of oleochemicals earmarked for cosmetic applications, the use of virgin coconut oil instead of copra derived oil will enhance the quality of the final product because of its hypoallergenic properties. One interesting development to note is that VCO is being focused on specific applications distinct from the traditional uses of coconut oil as listed above.

The current emerging major uses of coconut oil are as follows:

- As a nutraceutical and functional food
- As a hair and scalp conditioner
- As oil base for various cosmetic and skin care products
- As carrier oil for aromatherapy and massage oils.

At present, the use of VCO as a food supplement or functional food still accounts for the major percentage of VCO demand. However, there are indications that its demand for use in cosmetic and skin care products is also growing. In terms of pricing the use of VCO as a food supplement is still much higher than for cosmetic application

Current Developments that Favors the Growth of the Industry

The continuing publication of books and literatures and the growing number of internet websites extolling the health benefits of coconut oil is a big factor in making more people aware about it thereby creating more demand for the product. It is expected that the Philippine domestic market for VCO will further grow with the publication of the following books which are written by Filipino doctors. These are :

Rx Coconuts (The Perfect Health Nut) – dubbed as a doctor's prescription for weight loss, total health and beauty, the book was written by Dr. Vermen Verallo Rowell, Chief Dermatologist , Makati Medical Center and a Fellow of the American Institute of Dermatology. Aside from a well researched information on the effect of VCO for weight loss, it also describes the results of various clinical trials that Dr. Verallo's team at Makati Medical Center conducted on the antibacterial property of monolaurin and VCO and its effect for skin diseases. The book was published in the United States and was launched in Philippines on 15th July 2005.

The Truth About Cocout Oil (Drugstore In a Bottle) – the book was written by Dr. Conrado Dayrit, Professor Emeritus of Pharmacology, UP College of Medicine and Medical Director, Victor Potenciano Medical Center who was a practicing cardiologist even at the age of 86. Dr. Dayrit was

part of the team which conducted the first clinical trial on the use of coconut oil and monolaurin to HIV+ patients at San Lazaro Hospital in 1999. The book describes the fallacies and latest findings about atherosclerosis and heart disease which essentially negates the smear campaign levied on coconut oil by the American Soybean Association. It also presents medical analysis on the anecdotal reports of cancer, AIDS, and other patients afflicted by deadly diseases who have been cured by taking virgin coconut oil. The book was launched at SM Megatrade Hall during the celebration of Coconut Week on 26th August 2005.

On the other hand, Ms. Girly Sarmiento, Chief, Natural Products Division, Center for International Trade, Exposition and Mission, Philippine Department of Trade and Industry cited the following reasons why the market for VCO is expected to expand further for both local and international markets.

- Increasing consumer sophistication and interest in all things natural
- Increasing demand for therapeutic products (nutraceutical)
- Consumers are seeking alternatives or complement to pharmaceutical drugs to address modern health problems
- Entry of large pharmaceutical and over the counter (OTC) companies placing botanical medicine in their product line.
- Entry of mass and prestige market companies with their large advertising budgets
- The demographics is changing towards aging population whose minds are more open to alternative medicine
- There is an increased advertising budgets and media attention for botanical medicines contributing to rapid growth and awareness

Final Remarks

a. It is for the benefit of the coconut industry to promote the production, utilization and marketing of virgin coconut oil and gradually wean from the traditional process of oil extraction based on copra. In this way, the quality and value of the product is upgraded.

b The fast developing and high value niche market for virgin coconut oil offers a good prospect for the improvement of the life of the farmer. In as much as virgin coconut oil can also be produced on a micro and village scale of operation , it creates a situation where coconut farmers can directly participate and get a bigger share of the profit of the industry instead of being a mere producer of copra.

Acknowledgment

Heartfelt gratitude and thanks are extended to the God Almighty, for providing the author with the inspiration to write the paper and good health to be able to participate in the International Coconut Seminar; to the Coconut Development Board of India for the invitation as resource speaker and hospitality and to the Asian and Pacific Coconut Community (APCC) for providing the travel expenses to go to Goa, India.

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Note: This paper is a revised version of the paper presented at the International Coconut Seminar held in Goa, India in December 2005.

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