



Appropriate processing technologies for value addition in coconut

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Coconut production in Thailand is in the hands of smallholders. Three quarters of total production is sold as fresh nuts for cooking or other purposes, and the remaining quarter is converted into copra.



Virgin coconut oil

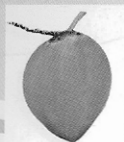
Abstract

Coconut plays an important role in the economy and on the daily life of Thai people. It is a major source of employment, income generation and food. Owing to low income from traditional coconut products such as mature nut, copra and coconut oil, product diversification for high value products is one approach that could increase farmer income. Coconut products are divided into two parts; edible and inedible products. The edible products are coconut chips, coconut sugar, nata de coco, young coconut, coconut milk, virgin coconut oil, coconut nectar, roasted young coconut, honey roasted coconut, coconut toffy, coconut baking custard, and dehydrated sweet coconut. The inedible coconut products are coconut shell handicrafts, coconut fiber, coconut midrib broom, coconut midrib basket, coconut soap, etc. The high value coconut products that have high potential for increasing income for women empowerment and poverty alleviation in Thailand are coconut shell handicrafts, virgin coconut oil and coconut sugar. The other products that have lower potential are dehydrated sweet coconut and honey roasted coconut.

Introduction

Coconut is widely grown in Thailand. In 2004, the total production of coconut was 1,199 million nuts from an area of 343,000 ha. Large scale coconut production is found in the Southern and Western regions. Coconut production in Thailand is in the hands of smallholders. Three quarters of total production is sold as fresh nuts for cooking or other purposes, and the remaining quarter is converted into copra. The major production areas are Prachab Kirikhan, Chumphon and Surat Thani. The varieties of planting are 91.74 per cent for mature nuts, 6.10 per cent for young coconut and 2.16 per cent for nectary coconut.

In Thailand, coconut is completely a smallholders' crop with about 1.0-1.5 ha per household on an average and coconut farmers almost live below poverty line. For mature nuts Thai Tall variety is used although a few are hybrids. The hybrids which the Department of Agriculture promote, are Sawi hybrid No.1, Chumphon 60 and Chumphon. No.2. Among the palms grown, the share of hybrids is only 10 per cent. Average farm income of farmers is US\$ 280 per hectare.



Coconut is a crop of great significance, since it plays an important role in the economy of the country and on the daily life of the Thai people. It is a major source of employment, income generation and food. Owing to low income from traditional products such as mature nut, copra and coconut oil, product diversification for high value products is one approach that could increase farmer income. However, due to declining farm productivity and unstable markets of coconut products, Thai coconut farmers have been facing a lot of difficulties in their coconut production and processing. The income from coconut is small when compared to fruit crops. As a result, their income which was small earlier, have now become the least.

Unlike other coconut-producing countries, Thailand produces mostly young coconut for fresh consumption of its water. Quite large areas are also grown with coconuts to provide raw material for the products of coconut milk, desiccated coconut, dehydrated coconut, coconut chips, coconut jelly (formed through fermentation of coconut water), coconut oil (by extraction of copra), etc. The palm's unopened inflorescence can be manipulated to yield coconut toddy which is processed into alcoholic drinks, or coconut sugar.

Coconut Products

Product diversification of coconut is divided into two parts;

1. *Edible products*

1. Coconut Chip
2. Coconut Sugar
3. Nata de Coco
4. Young Coconut
5. Coconut Milk
6. Virgin Coconut Oil
7. Coconut Nectar
8. Roasted Young Coconut
9. Honey Roasted Coconut
10. Coconut Toffy
11. Dehydrated Sweet Coconut
12. Coconut Baking Custard

2. *Inedible coconut products*

1. Coconut Shell Handicrafts
2. Coconut Fiber
3. Coconut Midrib Broom
4. Coconut Monkey
5. Coconut Midrib Basket
6. Coconut Calyx Flower
7. Coconut Guinit Flower
8. Coconut Soap and Lotion

Edible Products

Coconut chips

Coconut chip is the thinly sliced crispy coconut meat. It is fresh tasting, toasted, sweetened or salted. It is used as a snack food. It is almost a household product and a few are manufacturing on a commercial scale. Varieties suitable for coconut chip are dwarf varieties, Sawi hybrid No.1, tall varieties - Sri Lankan, and Thai tall. The nuts should be ten months old.



Coconut Chips

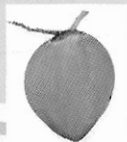
The processing of coconut chip involves the following steps:-

Separate the coconut meat from shell, remove paring with a sharp knife and slice meat with a peeler. Mix sliced coconut meat (87 per cent) in a mixture of 12 per cent sugar and 1 per cent salt and keep for 12 hours in refrigerator. Drain the water and dry the chip in indirect dryer at 70°C for 15-18 hours. Allow to cool, pack in plastic bag or moisture proof polyethylene/foil bags or store in tightly covered glass jars and label with sticker. For industrial purpose, pack in pouches of 30 gm and for household purpose in plastic cover of 100-120 gm.

The cost of production of a unit processing 250 small coconuts per day covering expenditure towards ingredients, labour, electricity and packaging is baht 1,226.8 or US \$ 29.9 per single dryer. Profitability is baht 953.2 or US \$ 23.2 per dryer, considering 160 batches per year. The gross income of coconut chip production per year is 149,512 baht or US \$ 3,646. Quality coconut chip will be having good flavour which will be accepted by the consumers.

Coconut sugar

Coconut sugar is mostly used for cooking desserts and curries and as raw material of food industries, eg. confectionery. Coconut sugar is made mainly by home industries in villages where coconut is grown. Export quantity has increased from 637,842 kg valued at baht 21,213,490 or US\$ 52,16,004.42 in 1998 to 1,007,269 kg valued at baht 19,520,315 or US\$ 47,99,684.04 in 1999. The United States of America is the biggest importer of palm sugar; others are



Manufacturing of coconut sugar

Australia, Japan, United Kingdom, France, Canada, Saudi Arabia, Germany, Hong Kong and Netherlands, respectively.

The process of coconut sugar manufacturing is divided into three steps- tapping of coconut sap, collection of coconut sap and coconut sugar processing. The palm is first tapped for sugar when the second spathe emerges. It is gradually pulled down and held in place with string, when the spathe is 40 cm long. After about 6 days the spathe should be correctly positioned for tapping. The spathe is cut about 6 cm from the tip. The sheath is peeled off, exposing the spikelets which are then tied down with a string. Sap is collected between 06.00 and 09.00 hrs and again between 15.00 and 18.00 hrs everyday. About 3 mm is trimmed off at every collection. A cylinder of bamboo or aluminium is placed over the end of spathe. A single spathe may be tapped for up to one month, and a good variety may have 2 bunches in production simultaneously. After filtering, the sap is poured into a large pan holding about 60 litres. This is heated to boiling, so that evaporation takes place and the syrup becomes sticky. The pan is taken from the fire and put on a tyre wheel. Slow continuous stirring is done to cool and stir the

syrup using a stirring device until it nearly becomes hard. Pour sugar into an aluminium container or mould. Evaporation takes about 2 hours usually between 10.00 and 12.00 hrs daily. The ratio between sap and sugar is about 7:1.

Cost of coconut sugar production is baht 282 or US \$ 69 per 30 kg container or 9.40 baht/kg or US \$ 0.23 /kg which includes labour, fuel, bark of tree, aluminium container and other cost (fertilizer, processing equipments, etc). Sugar production per year will be 1,928 kg./year/rai (1 ha = 6.25 rai). Farmer's gross income will be baht 25,071 or US \$ 3,917.34 /rai/year.

Nata de coco

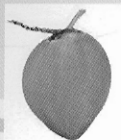
Nata de coco is a gelatinous dessert delicacy, produced by the microorganism *Acetobacter xylinum* on coconut water, sugar and acetic acid. Quality nata is smooth, clear and chewy. It is sweetened by boiling it in sugar and water solution. It is also used as an ingredient in other food products such as ice cream and fruit cocktail. Analysis of nata de coco cooked in syrup or nata de coco preserve shows that it contains 67.7 per cent water, 0.2 per cent fat, 12 mg per cent calcium, 5 mg per cent iron, 2 mg per cent phosphorus, trace of thiamine and protein and 0.1 microgram per cent riboflavin. Based on this analysis, nata de coco preserve may therefore be considered as a food without calorific value.

Nata de coco in Thailand is a household process. The process is divided into 3 steps; starter preparation, nata de coco production

and nata de coco in syrup. Ratio of raw nata de coco is 1 litre coconut water, 50 gms of refined sugar, 1 tablespoon of glacial acetic acid, 3 gms of ammonium dihydrogen phosphate and 200 ml of mother liquor of *Acetobacter xylinum*. This ratio can get 600-750 gms of raw nata de coco. The process of production is as follows.

Add refined sugar and ammonium dihydrogen phosphate to coconut water and bring to boil for 10 minutes, then allow to cool. Add glacial acetic acid and mother liquor, pour the mixture into clean, plastic container, incubate at room temperature for 8-12 days and nata de coco will be produced (thick 1-2cm.). Harvest and soak by changing water several times to remove the sour taste and smell for 3 days. Cut into cubes approximately 1 square cm or according to buyer specifications. Boil in clean water for 30 minutes and drain water out. For nata de coco in syrup, mix with refined sugar, ratio 1:1 together, leave for one night, put in jar, fill with hot syrup concentration at 45^o brix. Close container and sterilize in boiling water for 30 minutes. Allow to cool, label and it is ready for sales. The product can be stored upto one year. (for syrup: add 2 kg refined sugar, 1 litre water, bring to boil and filter before using.)

The cost of raw nata de coco production is baht 6-7 per kg or US \$ 0.16 including the cost of coconut water, chemical, refined sugar and microorganism. Selling price of raw nata de coco is baht 18 or US \$ 0.44 per kg (grade A) and baht 14 or US \$ 0.34 (grade B). The cost of



production of nata in syrup is baht 22 or US \$ 0.54 including cost of jar, refined sugar, raw nata and fuel. The selling price is baht 30-35 or US \$ 0.85.

Young coconut with opener

Young coconut with opener is coconut juice that has high nutritional value in terms of minerals and vitamins with flavor and freshness. Namphom young coconut, the variety especially from Thailand is used. That is the only stain of coconut with its own distinctive scent, good flavor and



Young coconut with opener

sweet taste. It is offered as a drink or a snack food and is good for health. Young coconuts are carefully selected for the best quality which come from the most well known coconut farm in Thailand so as to guarantee the quality of flavor and constant freshness all the year round. Globular shape, green skin, white tender and sweet flesh and scented juice are the criteria for raw material for processing. Australia, Europe, Japan, USA, Taiwan and Hong Kong are the countries that import young coconuts from Thailand.

Young coconuts are picked at eight months of age. The peeled fruit will have a diameter of 10 cm; its flesh weighs 100 gms and the shell 120 gms. The total weight of the whole peeled fruit (shell + water) is

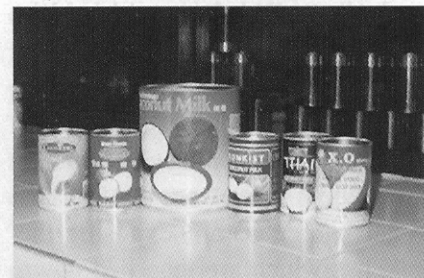
nearly 500 gms, with 250 gms of water inside the nut. In harvesting, the whole bunch is cut off with a rope tied to the bunch, which is then lowered to ground to avoid damage to nuts as well as to keep all fruits in the bunch for easy transport to the packing house. Normally, young coconuts are harvested every 20 days, or 16 times a year. Each bunch bears 10-15 fruits and about 50-70 fruit bunches are transported for trimming of individual nuts. A sharp knife is used to trim off the side (to a cylindrical form with a little tapering downward), the top (to a cone shape), and the bottom (flattened). Each trimmed nut is immersed in a solution (3-5 % sodium metabisulphite and 1-2 % fungicide thiobendazole) for 5 minutes, then dried. This is to avoid nut turning brown upon exposure to air. Wrap with PVC plastic sheet, attach the opener, straw and spoon and wrap with PVC plastic sheet again. Attach carrying strap for convenience in transport. Packing is done in a strong carton which maintains the quality of the product during delivery. The shelf-life is 45 days under 3-6 °C and 3 weeks under 7-10 °C.

The cost of production of young coconuts with opener is baht 20 or US \$ 0.49 per nut which includes cost of young coconuts and cost of trimming, solutions, plastic sheet, openers, packaging and transport. Young coconut without opener is baht 7 /nut. The capacity of production of Daothong brand is 1-2 containers per week (1 container = 6,480 nuts or 720 boxes) The selling price(FOB) with opener is

baht 32 or US \$ 0.78 and without opener baht 20 or US \$ 0.49.

Coconut Milk

Coconut milk is the white, thick liquid, extracted from freshly grated matured coconut. It is commonly called "Kathi". It contains fat, protein, vitamins, sugars, amino compounds and minerals. Coconut milk is used for edible purpose. It is best as an ingredient in various dishes like exotic curries and other dish milk and for preparation of desserts, etc. More than 12 factories are manufacturing coconut milk/cream in Thailand. USA, Middle East, Taiwan, Japan, Hong Kong, Australia, etc, are the countries importing coconut milk/cream.



Coconut Milk

The process of canned coconut milk: White coconut meat without paring is washed and soaked in chlorine solution (50 ppm concentration).

Keep in chilled containers, temperature below 15 °C and carry out water washing twice. Extract coconut milk with screw press, twice. The ratio of water depends on the percentage of fat. Pump coconut milk to steam jacket, boil at 90° C for 1 minute, add food additive (gum) for thickener. Second boiling at 90°C, 1 minute, homogenize at 2000 psi, hot filling in can, seaming, can washing, retort at



121°C, 75 minutes cooling and air drying. Keep in warehouse, label and pack into carton. Packaging of coconut milk is done in cans size No. 283,355,567 or tetra packs of 250 ml, etc. Shelf life is one year if properly stored in clean, cool and dry place, away from direct sunlight.

The export selling price depends on the company or market. Export market almost is in cans and domestic market in tetra pack. For domestic market, tetra pack (250 ml) is priced baht 10 or US \$ 0.24 and can 283 ml is baht 8.50 or US \$ 0.20.

Virgin coconut oil

Virgin coconut oil is generally processed from the coconut cream (upper layer, after the coco skim milk is separated) either by slow heating or fermentation /settling for 24 hours. If slow heating is done to recover the oil, the coconut protein obtained as a byproduct can be eaten as such or added to some food preparation. This is another byproduct for nutritional enhancement. However, if the recovery of the oil from the cream is done by fermentation or settling, the resulting byproduct cannot be eaten. When coconut milk is extracted from the grated coconut meat, a solid residue is generated as well. The residue which is normally thrown away, can be used as a food ingredient.

The processing steps for manufacturing virgin coconut oil is given below:

1. Select fully matured nuts(12-13 month old)
2. Split the dehusked nuts into two and grate the meat either

manually or thorough the use of motorized grater.

3. Extract the milk from the grated coconut meat either by hand or manually operated press. This can be hydraulic type or vertical screw type press. Set aside the milk obtained. Prepare the coconut milk residue or sepal for second extraction.
4. Do a second milk extraction by mixing water with the sepal obtained from the first milk extraction using a ratio of 2 parts sepal, 1 part water, and pressing again.
5. Mix thoroughly the first and second milk extract.
6. Allow the coconut milk mixture to stand for a maximum of three hours preferably in the refrigerator or in a container with ice.
7. Separate the cream (oily portion) from the coco skim milk (watery portion) by decanting. Set aside the skim milk.
8. Place the coco cream in a pan and heat very slowly to coagulate the protein and release the oil.
9. Separate the oil from latik by filtration using muslin cloth. Set aside the latik.
10. Place the extracted oil in a double boiler and heat for about fifteen minutes or until all residual water in the oil is removed.
11. Filter the oil to remove fine particles of coagulated protein.

12. Place the oil in a very dry bottle for storage.

The cost of production of virgin coconut oil is approximately baht 120 depending on coconut price and the cost of electricity and packaging. Fifteen nuts can produce one litre of virgin coconut oil. The bulk selling price is 300 baht per litre.

Coco burger is mainly made from residue (obtained as a byproduct in the production of VCO) and beef with spices and other ingredients. Okoy is mainly made from residue, grated pumpkin with shrimps, spices and other ingredients. The coconut residue can also be used for making cookies and macarons. Adding residue to various food recipes essentially fortifies the food products with dietary fiber and dietary fat which are essential for good nutrition. In addition, in the coco burger recipe, the residue acts as a meat extender in addition to the health benefits being contributed by the dietary fats and fibers. Dried coconut residue contains 31.9 per cent dietary fiber, 38.3 per cent fat and 5.1 per cent protein. The coconut fat is mainly composed of medium chain fatty acids which have been shown in several studies to have antibiotic, anti-obesity, anti-cancer and other beneficial effects on the human body. Likewise, it aids the body in absorbing micronutrients and vitamins.

Coconut nectar

Coconut nectar is a special beverage from coconut inflorescence. It is sweet, oyster white and translucent. It has high



nutritive value, vitamins and minerals. Coconut nectar or sap can be used in two ways; served fresh as a beverage, or processed into coconut sugar; both have been consumed by Thai people since time immemorial. The export market is USA, Hong Kong, etc.

The collected coconut sap is a ready-to-drink beverage once bark and inflorescence debris have been filtered out. Boiling is done at 100°C for 1 hour until concentration of solution becomes 18-20° brix. Leave the solution for 1 hour to sediment. The clear solution is filtered and mixed with boiling water and standardized to 15° brix. Hot filling in glass bottle, closing, sterilization at 121 °C for 15 min, cooling and labeling for sales are the next steps. The shelf-life is one year.

The cost of production is 110 or US \$ 2.69 per box (24 bottles), which includes cost for coconut sap, bottle, paper box, electricity and labour. The wholesale price is baht 130 or US \$ 3.17 /box. The retailer price is 9-10 bath or US \$ 0.23 / bottle. There are many brands in market eg. Co Co, Co Co Land, Sai Fetch, Nam Tan Chot, etc.

Roasted young coconut

Roasted young coconut is a product prepared by a process in order to sweeten its water and tender meat as well as to enhance their flavor. This product is almost consumed in the domestic market and some are exported to Malaysia, Hong Kong and Singapore. Nuts of Nam-phom, Nam-wan, Must and other dwarf varieties are used for the product.

The process consists of dehusking coconut, trimming the shell by a machine, boiling the nuts in a solution (2% sodium metabisulphite) for 20 minutes, drying and burning for finishing touch by exposing the nut to the fire for a minute or so until the shell itself shows signs of burning (perhaps to make it attractive to customers). The fruit is kept at room temperature for 3 days or in the refrigerator for larger storage. Chilling will make its water more refreshing to drink. The water from the roasted young coconut is quite refreshing as it is quite sweet and aromatic. The tender meat, which is easily removed from the shell, is also sweet and aromatic.

The cost of production is baht 3.25 or US \$0.08 /nut (includes cost of young coconut, labour, etc). Selling price (medium nut) is baht 5 or US \$ 0.12 /nut. Capacity is 3,000 nuts per day. Retail price in Bangkok is around baht 7-10 or US \$ 0.17 - 0.24.

Honey roasted coconut

Honey roasted coconut is a sweet, thinly sliced crispy coconut meat. Honey roasted coconut is eaten as a snack food. Matured coconut (green husk) is used for processing, and nuts of Thai tall variety is mainly used.

The method of processing is given below:

- Cut dehusked coconut into half
- Separate the coconut meat from the shell
- Paring with a sharp knife
- Slice the coconut meat with a peeler.

- Mix sliced coconut meat with a mixture of honey, sugar, margarine, sweeten condensed skim milk, molasses and salt.
- Dry in oven for half an hour.
- Agitate frequently for 15 minutes until it becomes crispy.
- Allow to cool, pack in PVC plastic bags of volume 200 mg and label.

Retailing price is baht 25 or US \$ 0.61 per pack or wholesale price is baht 16-17 or US \$ 0.40. The cost of production is baht 10 or US \$ 0.24 including cost of coconut meat, labour, electricity, packaging and solution mixture.

Coconut toffy

Coconut toffy is sweet, creamy flavor candy. Coconut toffy has a high fiber content and is reported to help prevent intestinal sluggishness. It is consumed in domestic market and manufactured at household level.

Method of preparation of coconut toffy:-

- Prepare coconut cream from grated coconut meat mixed with water.
- A typical recipe for coconut toffy uses about 1 kg coconut cream, 1 kg of coconut sugar and 250 gm of molasses.
- Mix coconut sugar with coconut cream and bring to boil
- Add molasses in a cooking pan and the mixture is heated to boiling again.
- The mixture is cooked until it hardens when dropped into cold water.



- It is then poured into a banana leaf or banana sheath
- Allow to cool slightly.
- Cut into the desired sizes and individually wrap in cellophane.

The cost of production per pan is baht 29 or US \$ 0.70 including cost of coconut sugar, coconut milk/cream, fuel and packaging which contains 13 packs of toffy (each pack is 10 pieces). The selling price is 5 baht or US \$ 0.12 per pack, baht 65 or US \$ 1.58 per pan. Net income is baht 36 or US \$ 0.85 per pan. The production in full capacity is 10 pans per day with total gross income being baht 360 or US \$ 8.78 per day.

Dehydrated sweet coconut

The dehydrated sweet coconut meat is eaten as a dessert. Young coconut meat is used for processing and green or yellow dwarf variety is mainly used.

The method of processing is:-

- Cut dehusked coconut into half
- Drain coconut water out
- Separate coconut meat from the shell
- Soak coconut meat in coconut water
- Pare the nut with a sharp knife
- Soak coconut meat in coconut water again
- Wash with clean water
- Cut meat with a sharp knife into two pieces in longitudinal by (depending on grading quality of final product)
- Soak in 10 per cent salt solution

- Mix sliced coconut meat with refined sugar and water in the ratio of 6:3:1 and boil for 1 hour or until it is dried
- Allow to cool and pack in PVC plastic bag.
- Labeling

Cost of production is baht 54.6 or US \$ 1.33/kg, (includes cost of coconut, refined sugar and gas for cooking. Labour cost not included). Retailing price is dependent on the grade, grade A is baht 90-100 or US \$ 2.3, mixed grade is baht 80 or US \$ 1.95 and sliced grade is 50 baht or US \$ 1.22. The average net income is baht 30.4 or US \$ 0.74 /kg.

Coconut baking custard (Khanom Mao Kaeng)

Coconut baking custard is Thai dessert cooked with coconut milk and coconut sugar or palm sugar. These desserts take time to cook and need more skill in their preparation than other desserts. Coconut baking custard (*Khanom Mao Kaeng*) requires at least six ingredients and takes at least 2 hours for its preparation. It is consumed almost by domestic market and manufactured in household processing units. Petchaburi province in the western region of Thailand is the well known province for this dessert.

Coconut baking custard, *Khanom Mao Kaeng*, is prepared by beating eggs with beater for about 2 minutes. Add sugar, coconut cream and beat another 2-3 minutes. Add taro root and stir in rice flour. Stir the mixture over low heat until it is very thick and rubbery. Remove from heat and

pour into a square aluminium plate. Bake about 35-40 minutes. Remove and set aside. The ingredients of coconut baking custard are 2 cups taro root, cooked and masked, 1½ cup of coconut sugar, 6 medium eggs, 1 cup of coconut sugar and 4 tablespoon of rice flour.

The cost of production per plate is baht 20 or US \$ 0.49 including cost of ingredients, packaging, electricity and labour. Selling price is baht 25 or US \$ 0.61 /plate. Average capacity is 150 plate per day. Gross income is baht 5/plate or baht 750 or US \$ 18.3 per day.


Inedible Products

Coconut shell handicrafts

Coconut shell handicrafts such as necklace, bracelet, bag, belt, ladle, buttons, lamp shade, tray, coffee pot, cup, serving set, spoon, serving spoon, gift set, ear ring, bowl, key ring, etc are made of coconut shell. They are sold in domestic and export market. In 1999 production income was more than baht 5,000,000. Coconut shell for handicrafts should be thick, and of round globular shape depending on the purpose of use. Importing countries are USA, Canada, Japan, Italy, Germany, France, Newzealand, Australia, Sweden, Holland, Malaysia, Singapore, Philippines, etc.



Coconut shell handicrafts



The process of making handicrafts consists of selection of hard, thick and fine shell and choosing color and shape of shell to suit the designs. Globular and round shape is always used. The steps of processing consists of cutting, trimming and polishing. For handle of products such as ladle, fish slice, spoon, serving spoon and serving set, conventional wood and coconut wood are used.

The cost of production depends on the product. For example a serving set cost baht 9 or US \$ 0.22 /piece, ladle baht 5 or US \$ 0.12 / piece. Selling price of serving set is baht 70 or US \$ 1.7 /piece and ladle is baht 15 or US \$ 0.37 /piece. The labour cost is not considered since they are manufactured at household level. The average gross income per person is baht 5,000 or US \$ 121.9 / month.

Coconut fiber

Thailand is producing brown fiber from mature nut. Texture is stiff, elastic, pliable, resilient and resistant to bacterial attack. Coconut fiber is used-for car seat stuffing, making mats, rubberised bed, upholstery cushion, etc. Thailand has 17 coir fiber processing plants. Export volume in 2002 was 18,617 metric tons with a value of US \$ 2,543,000. Taiwan, China and Malaysia are the countries that import big volume of coconut fiber.

Matured green or brown husks are sprinkled with water and fed to a machine called decorticator. The decorticator continuously beats the husk with steel paddles to separate

the mixed fiber from coir dust. The mixed fiber obtained from the first pass is cleaned by passing it again through the decorticator. It is then dried and baled. The finished product is 140 kgs per bale and bound with heavy straps.

The capacity of medium plant is 4.2 tons per day and the cost of production (husk, labour, fuel and electricity cost) is baht 6,534 or US \$ 159.4. Net selling price is baht 2.60 or US \$ 0.06 per kg or baht 10,920 or US \$ 266.34 per day. Profitability is baht 4,386 or US \$ 107 per day or baht 1.04 or US \$ 0.02 per kg.

Coconut monkey

Coconut monkey is a monkey doll, made of whole nut. This handicraft is sold only in domestic market. It is made in the tourism areas especially in the south. Thai tall, big nut is suitable for making the coconut monkey.

The coconut monkey making method:-

- Materials consist of whole mature nut, eyes, ribbon, lacquer, etc.
- Select matured coconut (12 months), triangular shape on the front side.
- Cut bottom and upper part, peel brown husk.
- Take coconut meat out.
- Make parts of hand and leg
- Prepare head of monkey by selecting small, thick husked nut and connect head part with monkey body.

- Decorate with sun-glass, ribbon and polish shell with lacquer.
- Add eyes and basement of monkey to stand.

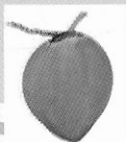
The cost of production is baht 20 or US \$ 0.48 (includes cost of coconut and other materials). The selling price is baht 200 or US \$ 4.9 per monkey. Net income is baht 180 or US \$ 4.4 per piece.

Coconut midrib broom

Coconut midrib broom is made from coconut leaf midribs. It is a household product in the coconut areas. It is made for domestic use and not exported.

The process consists of many steps:-

- The materials consist of coconut midribs, plastic string, elastic rubber string, bamboo stick for broomstick and nails.
- Select broomstick of 1.15 metre length.
- Screw at the top part, 5 cm apart from the top.
- Put the 12 cm small stick bamboo wood across the pole, wrap tightly with plastic string.
- Spread 35-39 midribs in a row and make as a sheet using plastic string until 70 cm wide.
- Put midrib sheet to connect tightly with broomstick using small nails.
- Wrap midrib sheet around broomstick until full.
- Fix with nails.



The cost of production including cost of coconut midribs, bamboo stick, plastic string, elastic rubber string, nails is baht 6 or US \$ 0.15 / piece of (not included labour cost). Selling price is baht 15 or US \$ 0.45. Net income is baht 9 or US \$ 0.2 / piece.

Coconut midrib basket

Coconut midrib basket is a basket made of coconut midribs. It is a household product. Matured, long coconut leaf midribs are used.

The cost of production (medium size) including cost of coconut midribs and plastic string is baht 4 or 0.1 US \$ per piece (not included labour cost). The selling price depends upon size. If it is medium in size, the price is baht 12 or US \$ 0.3. Net income is baht 8 per piece.

Coconut calyx flower

Coconut calyx flower is a flower made out of coconut calyx. The calyx should be fresh and green. It



Coconut calyx flower

is made at household level and can be done on commercial scale too.

The making of coconut calyx flower has many steps.

- The materials used are coconut calyx, color spray bottle, lacquer and flora tape.

- Select matured, fresh, green calyx from coconut.
- Dry in oven at 70 °C for 3 days or sun dry for 5 days
- Spray white color and follow with different color that is needed or natural color by polishing with lacquer
- Dry in the shade until it is dried.
- Bring together many flowers with flora tape

The cost of production including cost of color spray bottle, lacquer and flora tape is baht 125 or US \$ 3.

Coconut guinit flower

Coconut guinit flower is a flower from coconut guinit. Matured coconut can produce fine guinit. Thai tall is the best variety and better are dwarf and hybrid varieties, respectively. It is made at household level and can be made on a commercial scale.

The process involves many steps:-

- The materials consist of coconut guinit, flora tape, chemical, color spray bottles and vase metal string.
- Select guinit from coconut tree, still fresh not old. Bleach with 20 per cent chlorine, 2 hours for whitening (20% chlorine: Add 1 litre water to 200 gm chlorine)
- Dry in a shade for ½ day
- Cut guinit to follow the pattern of flowers, spray with white color in the first stage and follow with

different color that is needed in order to look bright.

- Bring all parts of flower patterns in the vase and mix together.
- Decorate with green leaves.

The cost of production including cost of spray bottle, flora tape, metal string, chlorine solution and vase is baht 128 or US \$ 3. Selling price is baht 300 or US \$ 7.3.

Coconut soap

Coconut soap and lotion are products produced from virgin coconut oil or coconut oil. The soap from virgin coconut oil is white in colour, produces smooth cream, and has good solubility in water. The coconut lotion contains natural ingredients and does not contain chemical preservatives that is harmful to the body. It can carry any favorite scent or blended with essential oils. The process can be done at village level.

The process for one kilogram of soap: Mix 608 gram virgin coconut oil, 104 gram of sodium hydroxide, 273 gram of water and 15 gram of aromatic essential oil and stir continuously until it is smooth. Pour into mould, leaving 24 hour or until it is hard. Take out from mould and leave for a month before use.

The cost of production is mainly for chemicals, virgin coconut oil and essential oil. The selling price is baht 20-25 per one soap.

Conclusion

Coconut is a crop of significance, since it plays an important role in

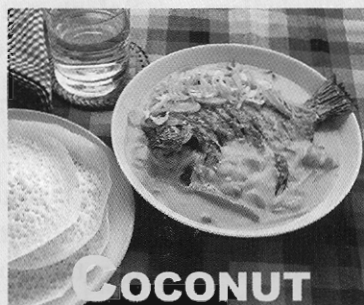


the economy of the country and on the daily life of Thai people. It is a major source of employment, income generation and food. Owing to low income from traditional products such as mature nut, copra and coconut oil, product diversification for high value products is one approach that could increase farmer income. Coconut products are edible and inedible. The coconut high value products that have high potential for woman empowerment and poverty eradication are coconut shell handicrafts, coconut sugar, virgin coconut oil, dehydrated sweet coconut and honey roasted coconut.

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COCONUT HOME FOODS

Kerala Appam

Ingredients:

Raw rice soaked for 4-5 hours	: 2 cups
Coconut shavings	: 4 cups
Cooked rice	: 1 cup
Yeast	: 1 pinch (dissolved in coconut water or lukewarm water)
Salt and sugar	: to taste

Method of preparation

Drain the soaked rice and grind it along with the coconut shavings and cooked rice to a fine thick paste. Do not add too much water. Coconut water may be preferably used instead of water for grinding. Add the yeast and mix lightly. Mix salt and sugar to taste. Allow to ferment at room temperature for at least 6 hours.

Heat a non-stick wok. Pour approximately half a cup of batter and quickly but gently swirl the pan around such that only a thin layer of the batter covers the sides and a thick layer collects at the center. Cover the lid and cook each appam on medium heat for about 3 minutes or till edges have become golden crisp (or when the edges start coming off the wok) and the center is soft and spongy.

Fish Curry in Coconut Milk

Ingredients:

Fish	: 1 kg
Whole chilli (red)	: 10 nos.
Onion (big)	: 1
Garlic	: 5 cloves
Turmeric powder	: ¼ tsp.
Green chilly	: 5 nos.
Tomato	: 2 nos.
Coconut milk powder	: 4 tsp.
Pepper (crushed)	: ¼ tbsp.
Lemon juice	: 3 tsp or for taste.
Curry leaves	: 2 stems
Ginger	: 1
Oil	: 2 tbsp.
salt	: to taste

Method of preparation

Clean the fish and cut into 1 inch pieces. Cut the tomatoes into medium size pieces. Chop the ginger. Crush the red chilli with garlic, pepper and ginger and keep aside. Fine chop the onions. Cut the green chillies lengthwise. Put the oil in a cooking pan and saute the onion and green chillies for 5 minutes. Then add the crushed chillies, pepper, garlic and ginger. Fry for 3 minutes until the smell of chilli comes out. Dissolve the coconut milk powder in 1 cup of water, add turmeric powder and let it boil. Then add the fish and salt. Cook well and add the tomato pieces. Cook for 5 minutes on a low flame. Add the lemon juice and curry leaves.