

PRODUCTION OF COCONUT FLOUR AND VIRGIN COCONUT OIL

I. Description

Coconut flour refers to the screened food-grade product obtained after drying, expelling and/or extracting most of the oil or milk from sound coconut meat. The meat is either pared or unpared. It is sub-classified according to its fat content (low, medium and high), protein content (high protein) and fiber content (high fiber).

Another co-product is **Virgin Coconut Oil (VCO)** which is the natural oil obtained from fresh, mature kernel of the coconut by mechanical extraction.

II. Manufacturing Process

The manufacturing of virgin coconut oil and flour involves two processing methods either by the:

1) Dry process which involves drying of grinded coconut meat, oil extraction and pulverizing the meal. The process produces a high protein coconut flour (33%) which can be used as wheat substitute.

The advantages of the this process is the high oil recovery at 88% based on the oil content of the meat (65%) or 58% of the dried granulated meat and good quality of the oil with a free fatty acid content of 0.1%. The dry process also produces high protein flour which can be used in making pan de sal and other baked products.

2) Wet process wherein the meat is extracted with milk, drying of the residue and grinding to produce the flour.

In the wet process, almost 52% of the available oil in the fresh meat is recovered. To optimize the oil extraction efficiency of the wet process PCA developed a technology to further extract the oil from the meal after milk extraction. The meal or residue that remains still contains a lot of oil - 35-48% fat content in which 38% colorless oil is recovered and 40% coco flour is obtained as a by-product. Instead of selling the residue as feeds this can be further processed to produce two high-value products, VCO and flour. The coconut flour is high in fiber content – 60% dietary fiber which can be used as a functional ingredient in the lowering of glycemic index and serum cholesterol levels.

The technology is applicable at small to medium scale level (5,000-10,000 nuts/day). The chart below summarizes the production flow of the coconut flour and VCO.

The equipment used are locally available and the main equipment for defatting coconut meat can be used for both fresh meat and residue for coco oil and flour production. However, some adjustments are needed in the operating parameters to meet the required quality of the products.

The economic viability of these processes is enhanced by the fact that two high value products are produced from a single raw material, namely, virgin oil and coconut flour. The high quality

natural colorless oil can be used as a base oil in aromatherapy products and as food supplement to provide instant energy to the body.

The technology on coconut flour and virgin coconut oil production from coconut residue was developed by PCA and the inventors – Dina Masa and Divina Bawalan which bagged Second Prize, Creative Research Category during the National Inventors Week in 1998. SODACO Agricultural Corporation commercialized the technology through a technology transfer agreement (non-exclusive) with PCA.

Quality characteristics of VCO produced from the PCA developed process:

Moisture content	0.08-0.13 %
Free fatty acids (as lauric acid)	0.01-0.09 %
Color	Colorless
Peroxide value	0-2.0 meq/kg oil

The shelf-life of the oil is more than one year.

The summary of the two processing options are shown in the following table:

Processing Options	Product Characteristic	Yield/ Recovery	Process Requirement
a. Fresh-dry Process	Cream or Light brown coco flour, high-protein, high or low fat; natural white oil Taste range from pronounced coconut flavor to bland taste depending on fat content	58% oil 33% flour of dried residue	Fresh coco meat with or without paring
b. Wet-dry process (patent pending)	Cream colored, high-fiber, low fat; natural white oil, coco milk Less coconut flavor due to reduce fat content	17% oil 26% flour of dried residue	Fresh residue after coco milk extraction

III. Classification of Coconut Flour

CLASSIFICATION/TYPES OF COCONUT FLOUR	REMARKS

- | | |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Whole full fat coconut flour | Coconut flour prepared from unpared dehydrated and edible coconut kernels by pre-pressing and solvent extraction. |
| 2. Coconut flour from pared | Coconut flour prepared from pared, coconut dehydrated and edible coconut kernel. |
| 3..Defatted coconut flour/Food | Coconut flour obtained from food-grade grade copra meal or copra that has been defatted by solvent/mechanical extraction. The resulting flour is brownish in color |
| Sub-classification:
a. low fat
b. medium fat
c. high fat | Coconut flour with 10-15% fat
Coconut flour with 16-25% fat
Coconut flour with 25-48% fat |
| 4. Low-fat, high-fiber coconut | Coconut flour from finely ground coconut flour residue “sapal”. The fat content of the resulting flour range from 10-15% and has a total dietary fiber content of more than 60%. |
| 5. High-protein, high-fiber | Coconut flour prepared from dehydrated finely ground coconut meat. |
| 6. Paring flour | Coconut flour prepared from the paring or the testa of the coconut. |
| 7. Copra meal | Coconut meat obtained after extracting oil for granulated copra. |

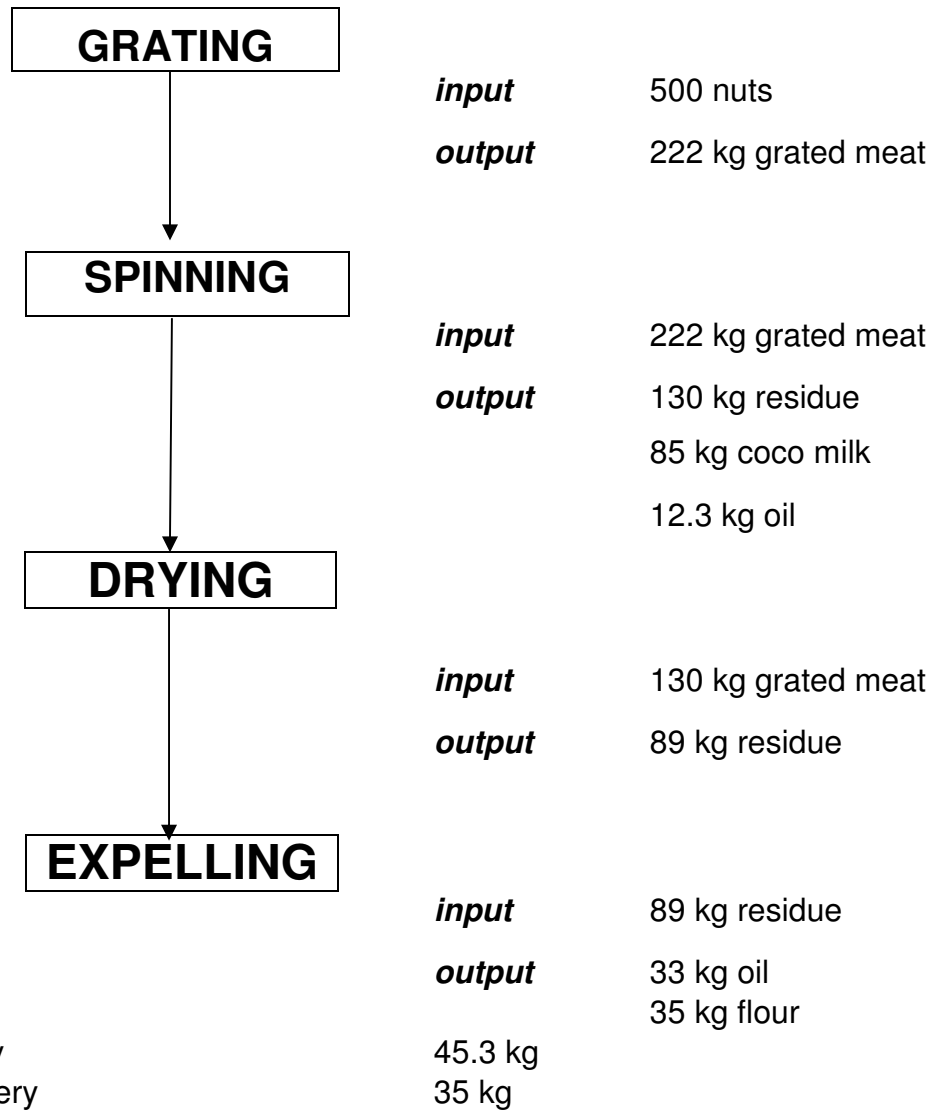
IV. Proximate Composition of Coconut Flour

	From Fresh-Dry Process (Peter Paul Coconut Flour)	From Wet-dry Process (SODACO Coconut Flour)
Moisture	4.5	6.7
Fat	10.7	10.9
Crude Fiber	40 (as dietary fiber)	60.9 (as dietary fiber)
Protein	17.5	10.8
Ash	5.5	3.168.5
Carbohydrates	61.8	68.5

V. Properties of Coconut Flour

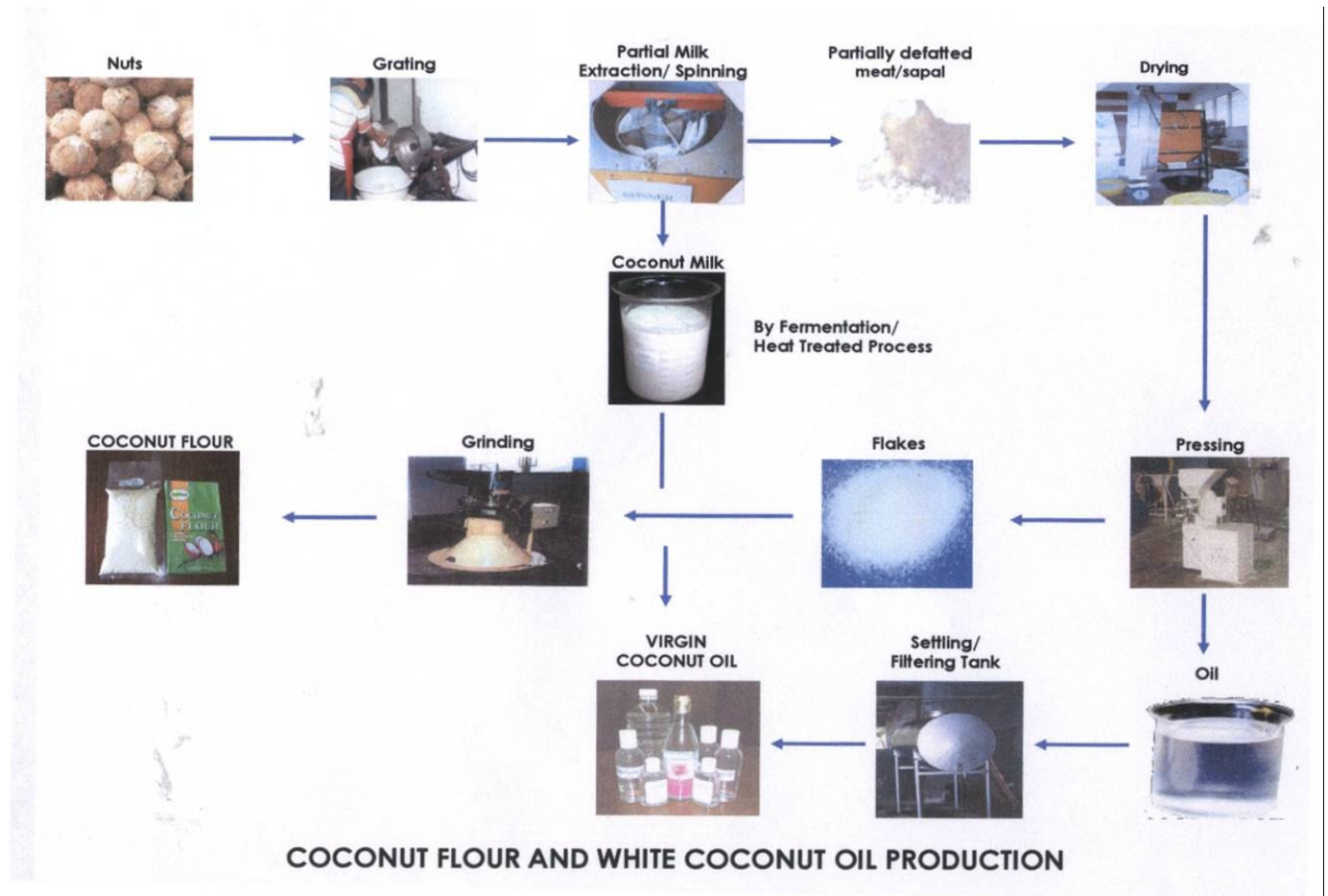
1. Coconut flour has a cream color and is less whiter than all-purpose flour.
2. Slightly nutty odor. It has less coconut flavor (almost bland taste) due to reduced fat content.
3. Coconut flour and Australian oat are bulkier and will occupy more space per unit volume than banana, all-purpose, hi-maize, Vitacel, and Quaker oat flours.
4. Coconut flour has a shelf-life of six months at room temperature Polyethylene plus kraft/chipboard/foil (metallized) and polyenthylene alone are suitable packaging materials.

PROCESS FLOW AND MATERIAL BALANCE FOR THE PRODUCTION OF VIRGIN COCONUT OIL AND FLOUR PRODUCTION (500 NUTS PER DAY)



LIST OF EQUIPMENT FOR THE PRODUCTION OF VIRGIN COCONUT OIL AND COCONUT FLOUR (500 NUTS PER DAY CAPACITY)

Equipment	Unit	Cost
Grinder / Pulverizer	1	45,000
Spinner	1	45,000
Dryer	1	190,000
Expeller	1	120,000
Grater	1	7,000
Building		
Land 100 sq m	500 / sq m	50,000
Building 60 sq m	2,500 / sq m	150,000



III. Applications/Uses of Coconut Flour

Coco Flour (High-Protein)

- ✚ As substitute for wheat flour in breads and cakes to provide the limiting amino acids in wheat flour
- can be used in nutrition feeding programs

Coco Flour (High-Fiber)

- ✚ As food supplement/additive in breads, cookies, snack food to provide dietary fiber sources
- can be used as fiber food to help in preventing constipation; as fiber food for patients with diabetes and moderately raised cholesterol levels

Popular breads & cakes that can be fortified with high- protein coconut flour:

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>10%</p> <ol style="list-style-type: none"> 1. Raisin bread 2. Ensaymada 3. Monay 4. Loaf bread 5. Pinagong 6. Pan de sal 7. Nutribun | <p>10-40%</p> <ol style="list-style-type: none"> 1. Chiffon cake 2. Cheese cake 3. Mocha-chiffon cake 4. Orange-chiffon cake 5. Butter cake |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Acceptable levels of coconut flour (high-fiber) as an additive in food products

Baked Products

- Multigrain bread 10%
- Chocolate chips 38%
- Chocolate crinkles 21%
- Oatmeal cookies 25%
- Cinnamon bread 10%
- Macaroons 25%
- Hotcake 15%
- Lemon poppyseed 15%

Snack foods

- Multigrain chips 10%
- Polvoron 15%
- Kroepeck 10%

Extruded Products

- Canton noodles 10%

IV. Market Aspects

A. Coconut Flour

Market demand of Coconut Flour

Wheat importation

YEAR	(MT)
1997	2,256,766
1999	2,332,487
2000	2,850,420
2002	3,084,410
2003	3,124,595

Source: US Wheat Association

If 5% of wheat flour will be substituted with coconut flour the potential market demand of high-protein coco flour is 156,230 MT annually. This will reduce our dollar importation of wheat.

Major Wheat Based Products

Pan de Sal	19%
Loaf bread	18%
Buns and rolls	6%
Other breads	4%
Noodles	21%
Pasta	1%
Crackers/ Cookies	18%
Cakes/ pies/ pastries	13%
Total	100.00%

Price (Local)

High Protein Coco Flour– 25 / kg
High Fiber, Low Fat Coco Flour – 90/ kg

Supply

Peter Paul Philippine Corporation (high-protein)	- 30 MT / mo.
Freyvonne Milling Services (high-protein)	- 4MT / mo.
Sirawan Food Corporation (high-fiber)	- 1MT / mo.

Total 11 MT / mo

Prospects

- ◆ Availability of convenient alternatives like bread, noodles, etc.
- ◆ Increase demand for healthy breads such as oatmeal, wheat, rye, multi-grain and others as more and more consumers are becoming health conscious
- ◆ Specialty breads like high fiber white bread are on the rise. People are becoming more conscious on quality and nutritional contents.
- ◆ The industry benefits from the government campaign on fortification of products like bread, salt, noodles, sardines and margarine.
- ◆ There is growing consumer base of 7.6 million which offer bright prospects on the medium term despite some short term market constraints.
- ◆ The feeding program to be spearheaded by the DA, NNC and Dep-Ed, if proven successful will create a market for high-protein coconut flour and encourage existing VCO producers to process further their by-products.
- ◆ The spread of coffee shops like Starbucks, Coffee California< Seattle's Best Coffee, etc. is expected to increase consumption of bread, a complement of coffee.
- ◆ The expansion of specialty bakeshops in other urban centers outside Manila.

Market Potential of Coco Flour

The National Supplemental Feeding Program (“Healthier Children, Wealthy Farmers Program”) is a large market for high-protein coconut flour.

The Department of Education has 167,000 grade 1 and pre-school children. The Department of Social Welfare and Services Department has 60,000 3-5 year old pre-schoolers in day care centers in 4th, 5th, and 6th class municipalities. At 120 days feeding regimen, this will require 28 tons of coconut flour for the production of “coco pan de sal”. The program is scheduled to start this August, 3005 and will be continued after the 120 days feeding once the local government units support the program for sustainability. The coco pan de sal will be fed together with dairy milk to be able to provide 1/3 of the daily RENI (Recommended Energy and Nutrient Intake).

B. Virgin Coconut Oil

Market Demand of VCO

Export Performance	MT	US\$
2001	1.8	19,810
2002	19.1	91,618
2003	113.0	406,580
2004	120	422,856

Countries importing VCO

	2001		2002		2003		2004 Aug.	
	MT	\$	MT	\$	MT	\$	MT	\$
USA	1.6	16,610	19,105 +14 pails	94,758	11.84 + 69 boxes	403,580	76.89 +2 drums	266,397.50
Hawaii	0.2	3,200						
Norway					1	4,000		
Korea							0.215	903.00
Japan							48 bottles	105.00
Netherlands							.54	3,528.00
Singapore							0.40	2,250.00
Malaysia							0.015	112.50
S. Africa							0.50	2,268.00

Supply

Production (Estimates)

2.a. Regional Capability (As of mid 2004)

	<u>MT/yr.</u>	<u>% share</u>
Luzon	30,300	83.8
Visayas	30	0.1
Mindanao	5,820	16.1

Source: PCA-MDD

Price

Local price of VCO ranges from P600 – P1,000 per liter

Export price of VCo ranges from \$ 3,134 / MT - 2004

Market Prospects

- ◆ Consumer demand for
 - functional foods
 - organic products
- ◆ Acceptance of herbal/natural medicine as alternative products to complement, if not replace, synthetic drugs.
- ◆ Increasing demand for safe, efficacious and quality natural therapeutic products considering burgeoning world population & high cost of drugs.
- ◆ Growing awareness on the value of food and nutrition in preventing diseases.
- ◆ Aging global population.
- ◆ Increasing interest in natural products, including beauty product line.
- ◆ Increased promotion & advertisement resulting for testimonials.