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STUDIES ON COCONUT SAPAL

I. CHALLENGES AND OPPORTUNITIES¹

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From merely an incidental crop in prehistoric times, coconut increased in importance so that currently it covers about 27% of the whole cropped area in the country. However, it gives a relatively poor return on investment. This may be caused in part by our preoccupation with the meat, which is largely made into copra — a rather low-priced product. There is need to increase the “value added” on coconut products which we put on the market and effectively utilize all the parts of the nut.

The *sapal* presents a unique challenge in that, if not utilized, it may present a pollution hazard. On the other hand, exploring its potential for food, feed, and medium for economically important microbes may yield benefits beyond our normal expectation.

1. An overview of the development of the Philippine coconut industry.

The coconut is probably indigenous in the Philippines, or it might have been introduced casually in pre-historic times and subsequently naturalized. This may be deduced from the fact that Chau Ju-kua (ca. 1200 A.D.) mentioned “coconut heart mats” as one of the items which the Chinese merchants obtained by barter from the “barbarian traders” (de la Costa, 1965). When the Spaniards came in 1521, Giovanni Gaetano, the Italian pilot of the ship *San Juan*, reported that among other items, palms and coconuts were present in the island of Mindanao (Scott, 1982).

The Spanish colonial government gave importance to the coconut when Governor-General Corcuera (1635) encouraged the people to cultivate the crop.

In 1768, a Royal Decree was issued requiring

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each well-to-do family to plant 200 coconuts, together with other listed crops (Velasco, 1986).

From this early beginning, the coconut industry grew to its present position in the economy of the country. As per the latest survey, the coconut occupies 3,274,940 hectares, or about 27% of the whole cropped area in the country (Table 1).

The country's coconut industry, however, is beset with problems in agricultural production, manufacturing, and trade. The average annual yield per tree over a five-year period for instance, is only 37.5 nuts (Table 2). At the rate of 129.8 g of dried meat per nut (Table 3), and at 150 trees per hectare, the computed yield per hectare is 0.73 tons of copra.

In 1985, the average price of resecada copra in Manila was ₱455.17 per 100 k. Hence, the estimated income per hectare is ₱3,322.74. This amount is to cover the rent on the land, cost of harvesting and copra-making, and cost of handling and marketing. It may be of interest to note that the daily wage of farm workers in 1983 was ₱14.59 (Philippine Yearbook 1985). Assuming that there are 250 working days per year, his computed annual income is ₱3,647.50. The Yearbook acknowledged that the daily wage rate was not enough to cope with inflation.

Compared with the sugar industry, coconut occupies eight times as much land area as sugar, but the value of its product is only 1.3 times as much as the latter. In terms of dollar earning from export, it earns 2.48 times as much as sugar (Table 1).

The main thrust of utilization is the coconut meat. About 90% of the nuts is converted into copra, 3% into desiccated coconut, and 2% is used as food nut. The country's export items consist of coconut oil, copra meal and desiccated coconut. (The government prohibited the export of copra since 1984).

The shell, although not fully utilized, account for part of the export earning in terms of coco-shell charcoal and activated carbon (Table 1).

It is disappointing that the Philippines has no export earning from coconut husk. According to the United Coconut Association of the Philippines (Ban-

Table 1. Summary data on various aspects of the coconut industry in the Philippines, 1985.*

Items		Amount
1. Land area in hectares		
All crops		11,865,487
Coconut		3,274,940
(Sugar		407,142)
2. Production in metric tons		
Coconut products		2,964,846
(Sugar		2,747,650)
3. Value of agricultural production in thousand pesos		
Coconut products		12,628,668
(Sugar		9,277,963)
4. Value of exports in FOB million US dollars		
All exports		4,629
Coconut products		459
Copra	—	
Coconut oil	347	
Desiccated coconut	75	
Copra meal	36	
(Sugar products		185)
5. Major uses of nuts in thousand nuts		
All uses		10,413,395
Copra		9,044,399
Desiccated coconut		378,591
Food nuts		216,081
Home-made oil		51,589
6. Copra meal Production in metric tons		
Total		543,899
Total Export	444,828	
Domestic sales	99,071	
7. Traditional coconut products (volume in metric tons; value in FOB US dollars)		
Coconut oil, volume	—	655,499
value	—	352,033,194
Copra meal, volume	—	444,828
value	—	35,917,660
Desiccated coconut		
volume	—	60,918
value	—	72,077,854
Coco-shell charcoal		
volume	—	32,579
value	—	6,311,791
Activated carbon		
volume	—	12,158
value	—	13,981,312

*Coconut Statistics Annual 1985.

zon and Velasco, 1982), an average fruit consists of 0.4 kg of husk; 30% of which is coir fiber. At an estimated annual production of 10 billion nuts, the computed coir fiber is 1.2 billion kg. If at all, the

Philippines hardly utilized this resource. By way of comparisons, India produced 155 thousand tons of coir fiber in 1974; Sri Lanka, 115; and the Philippines 2.5.

To sum up, it seems imperative that the Philippines (1) increase the productivity of coconut land; (2) improve the products being marketed by putting more "value added" on them; and (3) effectively utilize the by-products of the coconut manufacturing operations.

2. An assessment of copra as an article of trade.

Perhaps one would wonder why Filipino coconut farmers convert 90% of the nut yield into the low-priced copra and not into a better priced product. There are two apparent reasons for this: (1) copra can be traded because it is fairly stable, unlike the highly perishable coconut meat, and (2) copra-making does not demand much technical know-how and time on the part of the operator. Copra can be made by sundrying, by heating over a burning material, or by drying in an oven or kiln.

The copra of commerce is so degraded that it is unfit for human consumption. Copra is made under unsanitary conditions and it is usually loaded with microorganisms. When milled, the oil obtained from it has to undergo several stages of refining in order to make it edible. The residue or copra meal is not even good for animal feed.

It is rather imperative that the copra-making operations be improved, or an alternative scheme of rendering the oil be found.

3. The wet process of oil manufacture.

The scheme by which the meat is dried, then comminuted and pressed to extract the oil is termed the dry process of oil rendering. In contradistinction, the wet process is the scheme by which the fresh

meat is shredded or comminuted and pressed to extract the *gata* — an emulsion of water, protein, carbohydrates and oil. The emulsion is broken (i.e., separated into its components) by heating, or by the action of chemicals, enzymes and/or microorganisms. The desired ultimate products are oil and *latik*, a coagulate of protein and carbohydrates.

In a poor household or poor community, the protein and oil are good supplements to the nutritionally deficient diet of the people. This is a strong argument in favor of efforts to improve the wet process. The studies may in turn help sharpen the talent and ingenuity of local scientists and technologists. The other desirable features of the wet process are (a) it lends itself to low- or medium-scale operations; (b) it requires simple tools and equipment; and (c) it may provide employment on the farm.

On the other hand, some of its objectionable features are (a) the shredding of the meat from the shell is labor intensive; (b) the percentage of oil recovery is generally low; and (c) the products are highly perishable and prone to microbial infection.

A simplified scheme, which may be called *wet-cum-dry process*, was proposed by Kraus-Maffei. The comminuted fresh meat was run through an expeller at relatively low pressure to get the *sapal* and *gata*. The *sapal* is spread on a tray and dried in a kiln. (Drying of *sapal* is faster than that of the meat in copra-making because the meat particles are small and most of the cells have been crushed). On the other hand, the *gata* is mixed with an equal volume of oil and heated in a pan. Instead of an emulsion of oil in water, the *gata* becomes converted into an emulsion of water in oil. Moreover, the preponderance of oil allows the mixture to be heated to a high

Table 2. Annual average number of nuts produced per tree.*

Region	1981	1982	1983	1984	1985
Philippines	49	40	38	31	30
Ilocos	53	52	54	58	54
Cagayan Valley	49	38	26	36	44
Central Luzon	36	36	39	37	47
Southern Tagalog	66	39	30	21	17
Bicol	35	30	21	14	21
Western Visayas	38	37	34	40	31
Central Visayas	37	37	34	29	24
Eastern Visayas	29	27	23	19	20
Western Mindanao	44	36	39	26	22
Northern Mindanao	34	35	28	18	20
Southern Mindanao	60	59	65	65	61

*Coconut Statistics Annual, 1985.

temperature; hence a faster rate of water loss.

Sometime ago, the National Institute of Science and Technology, NSTA, established a one-ton capacity pilot plant for the production of canned *gata*. In the course of an 8-hour operation, it handled 420.3 kg of meat, 275.6 kg of shell, and 290 li of coconut water (Table 3). On being processed, the meat yielded 269.5 kg of *sapal* and 219.5 liters of skimmilk (Table 4). In a month's operation, the pilot plant is computed to accumulate eight tons of *sapal*, 6.6 tons of skim milk, and 8.7 tons of coconut water.

The writers took interest in the utilization of *sapal* because it takes longer to decompose than

Table 4. Processing data in the NIST pilot plant for canned coconut cream (*gata*).*

Fraction	Weight in Grams	Percent
Coconut Meat	159.5	
Sapal	102.3	64
Extract	129.5	
Cream (<i>gata</i>)	41.8	
Skim milk	83.3	

* Banzon and Velasco, 1982.

Table 3. Components of the nut at harvest (i.e., 12 months after pollination).*

Component	Weight/Volume		Percent (wet basis)
	Wet	Dry	
Whole nut, grams	1,084.6		
Husk, grams	518.5	182.0	47.8
Shell, grams	156.6	124.2	14.4
Meat, grams	244.5	129.8	22.5
Water, milliliter	165.0		

* Banzon and Velasco, 1982.

either skimmilk or coconut water; hence, it poses a greater pollution hazard. From another standpoint, the writers deemed it attractive to study the potential of *sapal* for food, feed, or growth-medium for useful microorganisms.

4. Observations on *sapal*¹ as food or feed.

Hagenmaier and colleagues (Hagenmaier, 1980; Banzon and Velasco, 1982) studied the flour produced through the Texas A and M process. It consisted of 5% moisture; 17% oil; 8% protein; 2% ash; and 68% carbohydrates (nitrogen-free extract). When they hydrolyzed the carbohydrates, they obtained 74% mannose, 21% dextrose and 5% unidentified fraction. (It may be recalled here that mannose is not utilizable by the human or animal digestive system, except that of ruminants).

¹In this study, no distinction will be made among *sapal*, copra meal and coconut flour. With the difference that *sapal* could have less protein and more oil, their properties which are mainly due to their carbohydrates content may be presumed to be the same.

Thieme (1968) cited data on the amino acid contents of copra meal as follows: arginine, 11% of protein nitrogen; leucine, 6.1; isoleucine, 5.3; valine, 5.2; tyrosine, 4.0; phenyl alanine, 3.9; threonine, 3.1 and lysine, 2.6. All the other amino acids were 1% or less. Grimwood (1975) indicated that compared with animal protein, coconut protein is deficient in lysine, methionine and threonine.

In attempts to use coconut flour as food, de Leon (1976) blended it with wheat flour to make several baked products. The snack items which she found acceptable were brownies, with 33% coconut flour; bars, 33; soda biscuits, 20; crackers, 25; crunchies, 12; figs, 50; loaf bread, 5; pasteleys, 34; tarts, 50; and pan de sal, 10%.

The limitations of the coconut flour for blending are: (1) its fiber content is high; (2) it gives a sandy or grainy "mouth feel" when present at 10-12% in the bread; and (3) its protein content is low, and the amino acid composition does not conform with dietary requirements.

In an attempt to determine the food value of copra meal (coconut press cake), Rao et al. (1965) reported that when the press cake was incorporated

in the ration, 11-year old boys consumed more food (increased feed bulk) and digested less protein (lower protein digestibility).

In chicken broiler ration, Gerpacio and associates (cited by Castillo, 1976) found that the feed containing 30% *sapa* in mash gave a protein efficiency ratio (PER) of 1.14 — i.e., there was 1.14 g gain in weight per gram of protein consumed. The standard broiler ration (control) gave a PER of 1.22. On the other hand, the pellet ration gave a PER of 1.39 for the ration with 30% *sapa* as against 1.48 for the control. The PER was even less in rations containing 40% *sapa*.

In swine feed, Creswell and Brooks (cited by Castillo, 1976) found that when coconut meal was added to the diet, there was a depression in digestibility of crude protein and dry matter. The digestion coefficient declined as the level of coconut meal in the ration (0, 10, 20, 40) was increased. However, there was a reverse trend in the digestion coefficients for crude fiber and other components. On the other hand, Castillo found that there was an increase in daily feed consumption and in daily gain in weight when the swine ration contained 20% copra meal; however, with 30% copra meal, these criteria decreased.

Using rats as test material, Miranda et al. (cited by Banzon and Velasco, 1982) reported the following nutritional indices for coconut flour; protein efficiency ratio, 2.15; total digestibility, (TD) 88; net protein utilization (NPU), 76; and biological value (BV), 80.

It would seem that studies should be conducted to (a) reduce, if not eliminate, the grainy "mouth feel," (b) reduce the mannose content, and (c) increase the quantity and quality of protein in order to improve the value of *sapa* for food and/or feed. Furthermore, studies to improve its quality as substrate for useful microbes is also deemed relevant.

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