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ABSTRACTS

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1981-1983

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81-83/607

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Key Words: Cattle, *Brachiaria brizantha*, *Centrosema pubescens*, Pastures, Feed crops.

A study on liveweight gain of Thai Indigenous-Brahman crossbreds grazed on Signal grass (*Brachiaria brizantha*)+Centro (*Centrosema pubescens*) and native grass + Centro pastures under coconuts was carried out in Lamae district, Chumphon Province from August 1978 - September 1980. There was neither a statistical significance in the weight gain of 79.0, 71.0 and 74.5 kg/animal of female cattle in the first year nor between 108.8, 78.0 and 38.8 kg/animal of male cattle in the following year under stocking rates of respectively 1.0, 1.5 and 2.5 animal/ha on improved pasture. The lowest stocking rate of 1.0 animal/ha grazed on native pasture gained 44 kg/animal in the second year experiment.

An evaluation on pasture yield revealed that different grazing pressures employed in this study did not affect herbage dry matter yield. However, pasture yield tended to decline in the second year. - Authors.

81-83/608

CHOMCHALOW, Srivan. Response of plants to polluted air environments 1. Growth of some plant species on island of Bangkok roads. (การตอบสนองของพืชต่อภาวะอากาศพิษ 1. การเจริญเติบโตของพืชบางชนิดบนเกาะกลางถนน) Rep. no. 1 on Res. Proj. no. 25-29, 1983, 32p. (In Thai.)

Key Words: Air pollution, *Michelia longifolia*, *Mimusops elengi*, *Tabebuia rosea*, *Jasminum sambac*, Pollutants resistance, Plants.

The experiment was carried out during November 1981 to July 1982 to study the growth of some plant species kept in heavy traffic road environments. Pots of plants under study were placed in seven spots. One in the compound of TISTR and the other six areas chosen were : (1) Entrance of Senanikhom Lane 1 (Phahonyothin 32), (2) Area in front of Lat Phrao Market, (3) in front of Northern Transport Bus Terminal (Mo Chit Market), (4) in front of Wat Phai Ton, (5) Saliratthawiphak Road, Saphan Khwai and (6) Sanam Pao. Four species of plants were studied, namely champi or white chempaka (*Michelia longifolia* Bl.), phikun or mimusops or bullet wood (*Mimusops elengi* Linn.), chomphu phanthip or tabebuia (*Tabebuia rosea* Dc.), and mali or jasmine (*Jasminum sambac* (L.) W. Ait). It was found that phikun grew best, followed by chomphu phanthip, mali, and champi, respectively. The sites at which phikun thrived best was Sanam Pao, and Senanikhom 1, while tabebuia grew best at Lat Phrao, followed by the area at Mo Chit Market. All species

grew normally at Lat Phrao and Senanikhom 1. White chempaka and jasmine planted at Saliratthawiphak and Sanam Pao shed their leaves almost completely, indicating that the ambient air in both sites created more pollution than the other sites. Responses of different plants to varying polluted air environments found in this study lead to the use of these species for further studies on pollution. The results also identified the species that were tolerant to the effect of pollution and could be grown in adverse environments caused by heavy traffic. - Author.

81-83/609

CHOMCHALOW, Srivan, CHANTARASAMEE, Manit, BOONMALISONT, Decha, POONSAWASDI, Sutep, PIYAPONGSE, Sachee and KAMOLRATANAKUL, Niphon. Pilot plant study of legume inoculant production. (ความเหมาะสมของการผลิตเชื้อแบคทีเรียปมรากถั่วขั้นอุตสาหกรรมนำทาง (PILOT PLANT)) Rep. no. 1 on Res. Proj. no. 20-07, 1981, 46p. (In Thai.)

Key Words: Nitrogen fixation, Legumes, Inoculation, Mung beans, Soybeans, Peanuts, Pilot plant study.

The TISTR's pilot plant research on legume inoculants has been made for the purpose of market testing and economic analysis in order to obtain data for feasibility study on the possibility of development on a commercial scale. The capacity of the pilot plant was 24 tons per year which are adequate only for 19,200 ha (120,000 rai). The area was less than 10% of the total targeted area for 1981. Experimental

results based on monthly checking have indicated that the inoculants for mungbean kept in cold storage at a temperature of 12-15°C were found to still maintain high productivity on the fifth month, having about 85% nodulation on tested in the green-house. The inoculants for soybean and peanut however, are valid only for 3 months. Field tests have been carried out in farming plots. The results have revealed that, there was an increase, on the average, of 14-35% over the uninoculated treatment.

From the analysis on investment and finance during the period of 5 years it can be concluded that approximately 3,040,000 ฿ have been spent on this project consisting of investment on fixed asset, circulating capital and pre-operating expenses. The investigation has also suggested that the plant should use its own fund since it is difficult to find sources for small-size loan, especially when the industry is only of a pilot nature. The cost of production included not only raw material but also other fixed costs consisting of general operating expenses, depreciation and repairs. It also covered distribution costs and profit taxes. The capacity of the plant was 24 ton/year. Owing to the limited market, the production targets were restricted to 12 and 18 tons a year for the first and second year respectively. An estimate of 24 tons annually was set for each of the third, fourth and fifth year. The analysis has revealed that for the price fixed at 50.000 baht/ton the internal rate of return was comparatively low, being 9,45%, with a break-even of 17.5 ton/year. If the price is increased to 50,000 baht

per ton the rate of return will be 15.45%. Thus it may be concluded that the industry is economically feasible for Thailand. However, the market for the product is, as mentioned earlier, rather limited. Thus, efficient public relations service is most essential for this new product. - Authors.

81-83/610

CHOMCHALOW, Srivan, KOVITVADHI, Kovit, PROMPHETCHARA, Smorn, CHALERMKLIN, Piya and JITNAVASARN, Samart. His Majesty's project on agricultural development of coastal sandy soil. (โครงการพระราชดำริการเกษตรดินทรายชายทะเล) Rep. no. 1 on Res. Proj. 23-07, 1983, 44p. (In Thai.)

Key Words: Coastal soils, Sandy soils, Agricultural development, King's project, Coastal agriculture.

In 1978, the Thailand Institute of Scientific and Technological Research, TISTR (Formerly the Applied Scientific Research Corperation of Thailand, ASRCT), was asked by Chumphon Province to cooperate in the Project on "Agricultural Development of Coastal Sandy Soil", the idea of which has been given by His Majesty the King in order to develop such an area. His Majesty has permitted that the project operates on a piece of land belonging to the royal property, about 442 rai at Tham Thong Village, Pak Klong District, Amphoe Pathiu, Chumphon Province. The project began in 1979, with the support both in the form of land clearing, road building and operating fund by Chumphon Province as well as other international and private institutes, such as, International Protein Research Company,

International Board for Plant Genetic Resources, Nithiwana Company, and the Coordinating Committee for His Majesty's Projects. The annual budgets from the government were also received during 1981-1984.

Two main activities were attempted at the beginning; first, the establishment of working and living facilities for the staff, the second, research and demonstration. However, research and demonstration works were actually started in 1982. At the present time, approximately 130 rai were cleared for housing, water supply system, road etc. and for research activities. The rest of the area will be cleared for research on economic important crops.

Observations made on crops under experimentation indicate that the rate of plant growth was very slow as would be expected from low fertility soil and low rainfall. However, the following species of trees and crops were found to demonstrate different degrees of adaptation (a) very good growth: *Casuarina equisetifolia*, *Eucalyptus camaldulensis*, *Acacia mangium*, *Albizia falcataria* (b) good growth: *Tamarindus indicus* Linn. (tamarind), *Mangifera indica* Linn. (mango), *Brachiaria brizantha* (signal grass), *Centrosema pubescens* (centrosema), *vigna sinensis* (vigna), *Hibiscus sabdariffa* (roselle) (c) fair growth: *Euphobia tirucalli* Lim. (euphobia), *Cocos nucifera* Linn. (coconut), *Leucaena leucocephala* (leucaena) (d) poor growth: *Jatropha curcas* L, *Psophocarpus tetragonolobus* (L.) DC (winged bean), and *Anacardium occidentale* (cashew nut).

In 1983, nine fruit trees were added to the experiment, namely *Artocarpus heterophyllus* Lamk. (jackfruit), *Sandoricum indicum* Cav. (santol), *Tamarindus* spp. (sweet tamarind), *Punica granatum* Linn. (pomegranate), *Ananas comosus* (L.) Merr. (pineapple), *Phyllanthus acidus* (L.) (star gooseberry), *Manihot esculenta* Crantz (cassava), *Baccaurea sapida* Buell. Arg (Chinese lantern tree) and *Annona squamosa* Linn. (castard apple). - Authors.

81-83/611

PATANAVIBUL, Siriphong, BOONKLINKAJORN, Prapandh and DURIYAPRAPAN, Soonthorn. Study on centro and siratro seed production. (การศึกษาการผลิตเมล็ดพันธุ์ถั่วเซนโตรซีมาและถั่วไซราโตร) Rep. no. 11 on Res. Proj. no. 20-15, 1981, 6p. (In Thai.)

Key Words: *Centrosema pubescens*, *Macroptilium atropurpureum*, Seed production, Feed crops, Legumes, Centro seed, Seratro seed.

An investigation on centro (*Centrosema pubescens*) and siratro (*Macroptilium atropurpureum*) seed production was carried out at Chumphon Forage Crops Station of the Livestock Development Department in Chumphon Province during August 1977-April 1979. It has been found that planting with the use of trellises produced significantly higher seed yield in both species, averaging 27.50 and 10.34 kg/rai/year as against the corresponding 15.26 and 7.75 for growing without the application of trellises. The effect of trellises on centro seed yield however was less significant in the second year, when the yield increased substantially. Furthermore, the variation

in spacing from 10 to 30 cm did not have any effect on the yield of both species. - Authors.

81-83/612

WICHAPAN, Kwanyeun, EUR-AREE, Ampon, VILAIRATANA, Parinya, KLONG-KARN-NGARN, Inson and CHOMCHALOW, Narong. Research on chrysanthemum tea production to replace opium in northern Thailand. Rep. no. 7 on Misc. Invest. no. 85 (Essential oil production in the highlands of northern Thailand), 1981, 40p.

Key Words: Chrysanthemum, Chrysanthemum tea, North Thailand, Highland agriculture.

In this report are included the results of research and extension work on chrysanthemum, carried out both inside and outside the Essential Oil Research Station, Chang Khian, Chiang Mai. This covers multiplication of planting materials for distributing to hill-tribes; selection of variety adaptable to the highland conditions to give high and superior yield which is disease resistible; investigation on fast propagating techniques; study on fertilizer application; and economic assessment of commercial production of chrysanthemum tea.

Extension work on chrysanthemum production was undertaken in 7 hill-tribe villages with a total area of 46 rai among which two curing factories including air-drying sheds and all facilities needed for chrysanthemum tea processing were established. The aim in establishing these curing factories is not only for curing purposes but also for further serving as prototyped plants in other villages. Training on

cultivation methods and curing techniques were given to the participants. The first prototyped factory was built at Mae Sa Mai and the second at Bo Kaeo. As a result, the curing complex was duplicated at Thung Luang by the Highland Agriculture Project, Institute of Agricultural Technology, Mae Cho.

Chrysanthemum tea bags were produced and packed in attractive packages specially designed for market tests to ascertain public acceptance on the products. Wholesale and retail prices were determined for different varieties of products displayed and sold in the Royal Agricultural Fair in March, 1981. The products has gained much interest from visitors to this Fair.

Not only was chrysanthemum tea sold at retail prices in the Fair but also in Chiang Mai and Bangkok markets at a wholesale price of 160 baht/kg. The average yield of dried chrysanthemum was 200 kg/rai, the gross value of which was estimated at 32,000 baht. The cost of production was calculated at 9,760 baht earning a net profit of 22,240 baht/rai. This is considered to be feasible as a home industry to substitute wholly or partially the import which amounts to about 40 t/year. Most of the 1980-1981 products were produced by the hill-tribes of Bo Kaeo and Hat Sompoi villages, Tambon Mae Sap, Amphoe Smoeng, Chiang Mai, under the cooperation of Royal Water Shed Development Unit 8.

As a follow-up responsibility, TISTR is at present maintaining an ample quantity of chrysanthemum stocks in

collection ready for multiplication whenever is needed. Planting materials accompanied with the technical know-how are always available for the farmers. In addition, TISTR in keeping close contact with the markets, is able to serve as a meeting place for the farmers and the buyers. Cooperation from extension service agencies is needed for carrying on this new occupation. - Authors.

AGRICULTURAL PRODUCTS DEVELOPMENT DIVISION

Food Technology Lab.

81-83/613

INTHORN, Duangduen. Desiccated shredded coconut. (มะพร้าวขูดชนิดแห้ง) Rep. no. 1 on Class. Invest. no. 21-34, 1982, 11p. (In Thai.) CONFIDENTIAL.

Key Words: Coconut, Desiccated shredded coconut, Food processing, Food industry.

Desiccated shredded coconut is made from the white part of the kernel after the brown testa has been removed. The fresh white meat was first shredded and then dried. The product may first be cut into small long pieces and reduced to shredded size. Good desiccated shredded coconut is of pure white colour with a fresh taste of the nut. The minimum oil content was sixty per cent and the maximum moisture content was 3 per cent. Desiccated shredded coconut is widely

used in confectionery and biscuit manufacturing and domestic cake-making. - Author.

81-83/614

INTHORN, Duangduen, MOLEERATANOND, Wiboonkiet, PATHOMYOTHIN, Wiwat and CHAVAJAROEN, Sompong. Development of roasted peanut snack. (การพัฒนาสูตรและกรรมวิธีการผลิตถั่วลิสงปรุงรส) Rep. no. 1 on Class. Invest. no. 25-01, 1983, 15p. (In Thai.) CONFIDENTIAL.

Key Words: Peanut, Roasted peanut, Snack.

Mostly peanut products which are popular in the country are either in the form of steamed or roasted peanuts with added flavoring agents and salt.

Roasted peanut snack was developed from good quality peanuts by removing shells and kernels, then followed by roasting and flavouring. The product has high nutritive value with approximately 26% protein and 48% fat content.

This report describes detail process of roasted peanut snack prepared from both deskinned whole peanuts and partially defatted peanuts. - Authors.

81-83/615

MOLEERATANOND, Wiboonkiet. Design of Spread-O-Meter for measuring consistency of food material. Rep. no. 1 on Class. Invest. no. 26-03, 1982, 10p. CONFIDENTIAL.

Key Words: Spread-O-Meter, Food inspection, Quality controls.

A quality control apparatus was designed, adapted and constructed for measuring consistency of premix starch batter prior to the extrusion process of transparent mung bean thread. It is specified as the "TISTR Spread-O-Meter". This is an inexpensive and simple apparatus that provides quick and easy measurement of the flow of starch batter purposively in terms of score. It will help solving problems on variation of personal judgement on the starch batter consistency during the process.

Eventhough, the primary purpose is to measure and control the consistency of starch batter in the mung bean thread factory, it is also useful for measuring in laboratory rheological behaviour of other types of food material such as fruit purees, sauces, preserves, and paste-like material. - Author.

81-83/616

PATHOMYOTHIN, Wiwat, INTHORN, Duangduen and CHAIKET, Intrawut. Preliminary study in development of supplement food: dry form. (การศึกษาขั้นต้นในการพัฒนาอาหารเสริมชนิดแห้ง) Rep. no. 1 on Res. Proj. no. 22-02, 1982, 17p. (In Thai.)

Key Words: Weaning food.

Supplement food in dry form for children was found

to be formulated by 20-28% equally of rice flour and wheat flour, 15-20% soybean and 8-12% skimmed milk powder. These compositions were mixed with water and flavouring agents until there was 50% moisture and then drum dried. Moreover eggs and pumpkins were added for other formulae.

The analysis result showed that the products contained 17% protein, 2-3% fat and 70% carbohydrate. The organoleptic test revealed that more than 60% of the taste panels were in favour of the products and there were no significant differences between the three formulae of supplement food in dry form. Only 5-15% were against. - Authors.

81-83/617

SRISAWAT, Suwanna. Improvement on the noodles' quality. (การปรับปรุงคุณภาพของเส้นบะหมี่) Rep. no. 1 on Class. Invest. no. 22-21, 1982, 19p. (In Thai.) CONFIDENTIAL.

Key Words: Noodle, Food industry, Product development.

81-83/618

VARANGOON, Pivan, INTHORN, Duangduen, PIYAPONGSE, Sachee, PATHOMYOTHIN, Wiwat, VIMOLCHALAO, Chote and KAMOLRATANAKUL, Nipon. Development of food products from ripe tamarind. Rep. no. 1 on Class. Invest. no. 23-05 (Development of food products from ripe tamarind), 1981, 41p. CONFIDENTIAL.

Key Words: *Tamarindus indica*, Food technology, Tamarind, product development.

Thailand Institute of Scientific and Technological Research, (TISTR), has developed three products from ripe tamarind fruits: concentrated tamarind pulp, extract, and syrup.

The concentrated pulp was prepared by mashing tamarind pulp, without seeds and fibre, with an amount of water until the required concentration of the paste was obtained.

The concentrated extract was obtained by extracting the ripe fruit pulp with water several times until virtually no acid remained in the residual pulp. The extract was then concentrated until the weight of the concentration was ten times that of the pulp.

The concentrated syrup was prepared by blending concentrated extract in syrup together with other flavoring agents.

The concentrated syrup can be diluted by adding four portions of water before serving. - Authors.

81-83/619

WANICHAYAKARN, Ruchie. Development of dehydrated guava. (การพัฒนาผลิตภัณฑ์ผลไม้ฝรั่งแห้ง) Rep. no. 3 on Class. Invest. no. 26-08, 1983, 10p. (In Thai.) CONFIDENTIAL.

Key Words: Guava, Dehydration, Food industry, Fruit preservation, Product development.

An experiment had been conducted by TISTR to study the process for manufacturing dried guava. The preservation

method involves soaking the fruits of guava in syrup before drying to a certain percentage of moisture and sugar contents.

The color of pericarp and flesh of the dried guava still remains green and pale yellow, respectively. There is no sign of sugar crystal adhered to the surface of the product.

The products can be kept at room temperature for not less than 4 months without microbiological spoilage.

A description of the processing method, chemical and microbiological analyses of the product during storage test have been covered in this report. - Author.

81-83/620

WANICHAYAKARN, Ruchie. Development of dehydrated jackfruit. (การพัฒนาผลิตภัณฑ์ขนุนแห้ง) Rep. no. 2 on Class. Invest. no. 26-08, 1983, 10p. (In Thai.) CONFIDENTIAL.

Key Words: Jackfruit, Dehydration, Food industry, Fruit preservation, Product development.

The study has been conducted by TISTR to establish the process for manufacturing dried jackfruit. The preservation method involved soaking the flesh of jackfruit in syrup before drying to a certain percentage of moisture and sugar content. The dried jackfruit shows no sign of sugar crystal on the surface.

The products can be stored at room temperature more than 5 months without microbiological spoilage.

This report covers processing method as well as chemical and microbial analyses during storage test. - Author.

81-83/621

WANICHAYAKARN, Ruchie. Development of dehydrated jujube. (การพัฒนาผลิตภัณฑ์พุทราแห้ง) Rep. no. 1 on Class. Invest. no. 26-08, 1983, 10p. (In Thai.) CONFIDENTIAL.

Key Words: Jujube, Dehydration, Food industry, Fruit preservation, Product development.

The study has been conducted by TISTR to establish the process for manufacturing dehydrated jujube from whole fruit. The preservation method involved soaking jujube whole fruit in syrup before drying process to provide a certain percentage of moisture and sugar contents. The dried jujube appears yellowish in colour. There is no sign of sugar crystal on the surface of preserved fruits.

Storage stability of the products is over 6 months without microbiological spoilage at room temperature.

This report covers processing method including chemical and microbial analyses during storage test. - Author.

81-83/622

WANICHAYAKARN, Ruchie. Development of dehydrated rambutan. (การพัฒนาผลิตภัณฑ์เงาะแห้ง) Rep. no. 1 on Class. Invest. no. 25-24, 1983, 9p. (In Thai.) CONFIDENTIAL.

Key Words: Rambutan, Denydration, Food industry, Fruit preservation, Product development.

The study has been conducted by TISTR to establish the process for manufacturing dried rambutan. The preservation method involved soaking the fruits of rambutan in syrup before drying the finished product to a certain percentage of moisture and sugar contents. The product was then packed and sealed in plastic bag.

The dried rambutan product has good appearance without sugar crystal remained on the surface. It can be stored at room temperature more than 5 months without microbiological spoilage.

This report covers the detail processing method including chemical and microbial analyses during storage test. - Author.

81-83/623

WANICHAYAKARN, Ruchie and CHAIKET, Intrawut. Development of jam from papaya pulp. (การพัฒนาผลิตภัณฑ์แยมมะละกอ) Rep. no. 1 on Res. Proj. no. 23-10, 1982, 18p. (In Thai.)

Key Words: Papaya, Jams, Food processing, Waste utilization, Product development.

This study deals with the utilization of papaya pulp after latex tapping to produce papain for the development of jam from the ripe fruit of papaya. The processed jam contained

not less than 37 per cent of fruit pulp and about 68.5 ± 1.5 of total soluble solid.

Papaya jam was processed by applying heat treatment to become gel formation. It can be kept in an ordinary room temperature for not less than 6 months without microbiological change.

An estimated cost of production at a capacity of 120 kg/day is included in this report. - Authors.

81-83/624

WANICHAYAKARN, Ruchie and INTHORN, Duangduen. Development of dehydrated mango pickle. (การพัฒนาผลิตภัณฑ์มะม่วงแห้งจากมะม่วงดอง) Rep. no. 1 on Class. Invest. no. 26-01, 1983, 14p. (In Thai.) CONFIDENTIAL.

Key Words: Mangoes, Dehydration, Pickle, Food industry, Fruit preservation, Product development.

An experiment has been conducted by TISTR to study the process of manufacturing dehydrated mango from the salted and acidified pickled mango called "Kaew" (*Mangifera indica*) by soaking the mango slices in syrup before drying, the products would contain sugar with less than 16% of moisture.

A description of the processing method, chemical analysis and products consumer acceptance test, has been covered in this report. - Authors.

81-83/625

WANICHAYAKARN, Ruchie and PAKLAMJEAK, Mayuree. Development of dehydrated mango manufacturing. (การพัฒนาผลิตภัณฑ์มะม่วงแห้ง) Rep. no. 1 on Class. Invest. no. 25-19, 1983, 18p. (In Thai.) CONFIDENTIAL.

Key Words: Mangoes, Dehydration, Dehydrated mangoes, Food industry, Food preservation, Product development.

An experiment has been conducted by TISTR to study the process in manufacturing dehydrated mango from mature mango (*Mangifera indica*). The preservation method involved soaking mango pulp in syrup before drying process to provide the product containing a certain percentage of moisture and sugar content. The dried mango was orange in colour and crystally clear in texture. There was no sign of crystal on the surface of the outer flesh.

The product can be kept in ordinary room temperature for not less than 6 months without microbiological change.

A description of the processing method, chemical and microbiological analysis of shelf-life testing samples and a study on the packaging of dehydrated mango products are included in this report. - Authors.

81-83/626

WANICHAYAKARN, Ruchie, INTHORN, Duangduen and NUMCHAISEVATANA, Sakda. Paste form convenient supplemented food from vegetable and meat. (การพัฒนาอาหารเสริมสำหรับเด็กชนิดเหลวข้นจากผักและเนื้อสัตว์)

Rep. no. 2 on Class. Invest. no. 21-32, 1983, 28p. (In Thai.)
CONFIDENTIAL.

Key Words: Weaning food, Supplemented food.

Paste form convenient supplemented food has been processed by using local raw materials such as soy bean, rice and white sesame seed mixed with vegetables and meat, such as ivygourd leaves, pumpkin, tomato, pork liver, chicken and eggs. Each type of supplemented children food was fortified with suitable amount of vitamins and minerals to provide six formulas of paste form supplemented food, different in colour and flavour. Food derived from these six formulas did not differ much in food value.

The nutritional contents in these experimented food formulas were found to be comparable to the standard requirements set by the Public Health Ministry of Thailand as supplemented food for children, age 6 - 14 months old.

A description of the processing method, materials and equipment, chemical analysis, results of food acceptability test and estimated cost of production has been included in this report. - Authors.

81-83/627

WANICHAYAKARN, Ruchie, VARANGOON, Pivan and CHATKET, Intrawut. Development of high protein precooked food. (การพัฒนาอาหารเสริมกึ่งสำเร็จรูป) Rep. no. 1 on Class. Invest. no. 21-32, 1981, 22p. (In Thai.) CONFIDENTIAL.

Key Words: Food technology, Rice, Soybean.

Two formulae for supplemented precooked food from locally available raw materials have been developed from rice and soybean. For the first formula dehulled soybean has been used as main ingredient, whereas for the second the defatted bean flavoured with malt flavour and fortified with a suitable amount of vitamins and minerals. This helps solve the nutritional problems for children and convalescence.

The product was precooked by drum drier to provide convenience in preparing food flakes. Only by adding to the product a desired amount of boiled water, milk or soup, it is ready for serving.

A description of the processing method, formula, chemical and biological analysis, shelf-life of product and consumers acceptance has been dealt with in this report. - Authors.

Packaging Technology Lab.

81-83/628

CHERDCHAI, Kunnika, SIRIKAN, Niran, SUKASEAM, Prasert and SWATDITAT, Amornrat. Longan basket. (เข่งลำไย) Rep. no. 11 on Res. Proj. no. 21-22, 1982, 16p. (In Thai.)

Key Words: Longan, Bamboo baskets, Containers, Bamboos, Packaging.

Two types of bamboo, Sang and Srisuk, are used to make longan baskets. There is a minor difference in the process and cost of producing these baskets. The highest compressive strength of a basket made of Srisuk bamboo was found to be 142 kg, and that of Sang bamboo, only 63 kg. The study has further revealed that the strength could be increased by vertical reinforcement with bamboo clumps of pieces. This results in compressive force being raised up 2 to 4 times, depending on the type and size of bamboo used.

Considering the cost of bamboo alone the price of a basket made of Srisuk bamboo is about 5 - 7 baht as against 2 baht for that made of Sang bamboo. Traders, however, buy these two types of basket at the same price and sell both at the same price. Lids of the baskets are bought by wholesalers for 7 baht per bundle (containing 10 pieces), which are then sold out for 10 baht. The corresponding cost per bundle is

5 baht. During the longan season, the price is about 17 baht per set of basket but normally it may range from 12 to 20 baht. - Authors.

81-83/629

CHERDCHAI, Kunnika, SWATDITAT, Amornrat and SIRIKAN, Niran. Transporting longans for export. (การขนส่งลำไยเพื่อการส่งออก) Rep. no. 13 on Res. Proj. no. 21-22, 1983, 13p. (In Thai.)

Key Words: Longan, Packaging, Export, Containers, Bamboo baskets, Plastic baskets.

Longans are exported to destination markets by trucks, airliners, ships and a combination of these. Transport containers mostly used are bamboo baskets. Only quite recently that plastic baskets and corrugated fibre boxes have been introduced for use as longan containers.

When longans were exported to Singapore by truck, the baskets were soaked in cold water, then loaded either in truck or refrigerated truck, and putting ice on top of the baskets. The temperature of longan was decreased from 30°C to 8.6 - 11.3°C when recorded at Hat Yai. However, this method of cooling can be applied to bamboo and plastic baskets only.

Longan could be exported to Singapore by 3 ways. The cost of transporting by air refrigerated trucks and ships came to 10.10, 9.20 and 5.60 baht per kg respectively. The

corresponding transporting time was found to be 14, 54 and 72 hours. Shipping longan to Hong Kong was mostly done by air either in Thai cargo or passenger airliners. It took only 3 hours from Chiang Mai to Hong Kong by air cargo at the cost of 12.40 baht per kg. If longans were carried by trucks to be transported by airliners from Bangkok Airport, the transporting time would be about 14 hours at the cost of 10.90 baht per kg. - Authors.

81-83/630

PAKLAMJEAK, Mayuree. Prediction of shelf-life of packaged food product by mathematical models. (การคาดคะเนอายุการเก็บของผลิตภัณฑ์อาหารโดยใช้รูปแบบทางคณิตศาสตร์) Rep. no. 10 on Res. Proj. no. 21-22, 1982, 14p. (In Thai.)

Key Words: Packaging, Food storage, Keeping quality, Food products.

The moisture sensitive food product used as an experimental sample in this study was high protein snack food for children with initial moisture content of 4.0%. The curve of moisture sorption behaviour of the product under different relative humidities was sigmoid. It was found that the critical moisture content was 6.5% which corresponded to relative humidity of 55.0% as judged from physico-chemical properties.

Prediction of the shelf-life of food product packed in two different size and film-thickness of polypropylene pouches at a temperature of 27°C and 80% relative humidity was

made on the basis of two selected mathematical models. The calculations showed that the shelf-life of the big pouch made of 54.1 μ film, with a packing surface area of 1080 cm^2 and 250 g content, was 62 - 63 days; while that of the small pouch of 77.2 μ film, with a packing surface area of 450 cm^2 and 75 g content, was 77 - 79 days.

Comparing the estimated results to the real shelf-life of the packaged products which were 60 days for the big pouch and 75 days for the small one, the percentage difference was in the range of 2 - 5, and this might probably be due to some assumptions in the development of models. However the two models are considered as applicable to some moisture sensitive food products for prediction of approximate shelf-life within a shorter time and entails lower cost when compared with the "Accelerated test" method. The application of such models to package designing is expedient in selecting the most suitable materials which will bring about the fullest economic benefit, and at the same time ensure the required shelf-life of the product. - Author.

81-83/631

SIRIKAN, Niran and SWATDITAT, Amornrat. Development of bamboo containers for agricultural produce. (การพัฒนาภาชนะบรรจุทำจากไม้ไผ่ สำหรับผลิตผลเกษตร) Rep. no. 12 on Res. Proj. no. 21-22, 1983, 16p. (In Thai.)

Key Words: Bamboos, Containers, Packaging, Agricultural product, Postharvest technology, Bamboo baskets, Bamboo boxes, Bamboo crates.

In this study two types of rectangular bamboo containers for agricultural produce were considered. One was woven bamboo boxes with lid, and the other bamboo crates without lid. Woven boxes were made of 2 types of bamboo, sisuk and ruak bamboo, with a common dimension of 400 mm x 300 mm x 200 mm. Each woven box contained about 10 kg of fruit. The weight of each box made of sisuk and ruak bamboo were 1,122 g and 932 g respectively. The vertical compression force per box was 345 and 273 kg respectively. There was no sign of dilapidation when these boxes were experimented in a free fall test. However, when they were tested on an oscillating and vibration table, the one made of sisuk bamboo showed no deformation, but the other did. The vertical compression force of a woven box could be increased from 1.8 to 10.2 times by using various methods of reinforcement.

Bamboo crates, without lid, had four standing posts. These posts had ends sticking up so that each end fits into the upper crate. By this means a number of crates can be stacked, one on top of the other. There were three different types of crate. The dimension of the first and the second types corresponded to 400 mm x 300 mm x 200 mm, while the third, 600 mm x 400 mm x 300 mm. The weight of a crate for the three types were 2,310, 1,412 and 3,000 g respectively. Every crate possessed the same vertical compression force of 2,240 kg. None showed any deformation when checked by a free fall test, and an oscillating and vibration test. The maximum sag of bottom was within limit.

The development of bamboo containers can first be promoted to the level of cottage industries. The next step is to study the acceptability of these models as developed. Consideration should also be made to determine the reasonable prices of these containers including the experimental implementation of these containers in exporting agricultural produce. - Authors.

Post-harvest Technology Lab.

81-83/632
TONGDEE, Sing Ching. Survey on packaging of horticultural products in Thailand. Rep. no. 3 on Res. Proj. no. 24-01 (Improvement of post-harvest handling and storage of horticultural crops), 1981, 20p.

Key Words: Packaging, Bamboo baskets, Fibreboard boxes, Wooden boxes, Horticultural crops.

A survey was made on the types of packages used for horticultural products in Thailand. The most common are the bamboo baskets of various types and sizes used for a wide range of products including fruits, vegetables, and root crops. Wooden boxes are mostly used for citrus, mango, and mangosteen. Fibreboard boxes are used for fruits destined for export. Detailed information on specifications and performance are given for selected samples of packages. Compression forces at peak load when packages deformed ranged 10-220, 280-620 and 3,750-6,800 kg for bamboo baskets, fibreboard boxes and wooden boxes respectively. - Author.

81-83/633

TONGDEE, Sing Ching, SCOTT, K.J. and McGLASSON, W.B. Effect of maturity and temperature on storage of bananas in polyethylene bags. Rep. no. 4 on Res. Proj. no. 24-01. (Improvement on postharvest handling and storage of horticultural crops), 1982, 7p.

Key Words: Banana, Storage, Polyethylene bags, Postharvest handling, Horticultural crops.

Banana fruits of three maturities were stored in sealed polyethylene bags and held at 20, 30 and 37°C. Ethylene, CO_2, and O_2 concentrations inside the sealed bags were measured during storage. The bags were opened after 17 days and the fruits held at 20°C to ripen.

The effect of maturity on the storage life of the bananas was most evident at the higher temperatures. Fruits of all 3 maturities stored at 20°C ripened normally. Fruits of the most advanced maturity (M_3) stored at 30°C ripened abnormally, but ripening of less mature fruits was normal. All fruits (M_1, M_2, M_3) stored at 37°C ripened abnormally probably due to heat injury. Ethylene accumulation was very low in bags held at 37°C. - Authors.

81-83/634

TONGDEE, Sing Ching, SCOTT, K.J. and McGLASSON, W.B. Postharvest handling and storage of lychee fruit. Rep. no. 2 on Res. Proj. no. 24-01 (Improvement on postharvest handling and

storage of horticultural crops), 1981, 10p.

Key Words: *Litchi chinensis*, Postharvest handling, Lychee, Storage, Horticultural crops.

Detached lychee fruit exhibited a non-climacteric respiratory pattern. Respiration (25-35 ml $CO_2 . kg^{-1} . hr^{-1}$) at 20°C decreased slightly during storage. Ethylene production increased from trace levels to about 0.4 µl. $kg^{-1} . hr^{-1}$ after 14 days storage as the fruit senescent. A decrease in titratable acidity occurred as fruit matured. This may provide a maturity index for the determination of harvest date. A natural pH indicator was observed in the fruit juice. It changes colour at pH 6.7-7.0 during titration. Storage of fruits in plastic covered punnets was compared over 40 days at 0°, 5°, 10°, 13°, and 20°C. The effects of a fungicide (hot benomyl) on respiration of lychee was also measured at 20°C. Chilling injury occurred when fruit were stored at temperatures below 7°C for 30 days. Several species of fungi associated with lychee in storage were isolated. - Authors.

INDUSTRIAL RESEARCH DIVISION

Fermentation Technology Lab.

81-83/635

ATTHASAMPUNNA, Poonsook, CHAOWSANGKET, Montri. DAENGSUBHA, Wanchern and NIYOMWAN, Naiyana. Studies on wet treatment of

bagasse using microbial liquor. (ศึกษาการเก็บรักษาชานอ้อยด้วยจุลินทรีย์) Rep. no. 1 on Class. Invest. no 22-14, 1981, 24p. (In Thai.) CONFIDENTIAL.

Key Words: Bagasse, Storage, Biotechnology, Microbial liquor.

Two methods on wet storage of bagasse with the application of liquor containing bacteria derived from the material itself were carried out on a laboratory scale. - Authors.

81-83/636

NUTALAYA, Siengtong, PATARAGETVIT, Sampao, SRITRAKUL, Anchalee and SRIMANEE, Somsakdi. Button mushroom cultivation. (การเพาะเห็ดกระดุม) Rep. no. 1 on Res. Proj. no. 23-18, 1983, 18p. (In Thai and English)

Key Words: Button mushroom, Chiang Mai, Cultivation, Mushrooms.

Experiments on button mushroom cultivation have been carried on by the Thailand Institute of Scientific and Technological Research (TISTR) at the mushroom growing yard, Ban Yang Village, Fang District, Chiang Mai Province. The effects of various parameters on the yield of the mushroom production have been investigated. These parameters are pH of composts, type of casing soil, mushroom strains and storage time of spawns. From the results, it can be concluded that the aver-

age yield per square meter is maximum when using the following processes:- pH of compost at 7.35, strain No. A_{22} and one month storage time of spawns. - Authors.

81-83/637

SUKHUMAVASI, Jiraporn and SUYANANDANA, Puangpen. Amylase production by submerged culture method. Rep. no. 2 on Res. Proj. no. 19-13, 1982, 18p.

Key Words: Amylase, Biotechnology, *Aspergillus wentii*, Cassava starch, Soybean milk.

Thailand has so far not produced amylase for commercial purposes. The enzyme processes employed in food and drinks industries depended on importation. The purpose of this study is to approach the objective of producing small-scale enzyme for local demand. Therefore, an attempt was made by seeking the potent strains of mold which have the ability of producing amylase from low-cost agricultural surplus or waste materials and which would give highest yield and yet retain the production capability under a wide range of environmental conditions. The screening of potent strain and the production of amylase were manipulated on the basis of "submerged culture method." The modification of the media by the variation of carbon and nitrogen sources as well as the optimum condition for amylase production were investigated. The results show that out of the 137 strains of mold, the *Aspergillus wentii* TISTR 3140 was the most potent strain which could grow in wide pH range of media. The concentration of carbon source, cassava starch,

which gave the best yield (on cost basis) was one per cent; and the soybean milk was the best of local nitrogen sources. - Authors.

81-83/638

SUKHUMAVASI, Jiraporn, NUMCHAISEWATANA, Sakda, VIMOLCHALAO, Chote, ATTHASAMPUNNA, Poonsook. The production of soy sauce from soybean. (กรรมวิธีการผลิตน้ำซีอิ๊วจากถั่วเหลือง) Rep. no. 1 on Class. Invest. no. 25-27, 1983, 39p. (In Thai.) CONFIDENTIAL.

Key Words: Soybean, Soy sauce.

The purpose of this project is to make a feasibility study for the semi-pilot industrial scale production of a new brand of soy sauce made from soybean. The research result shows that there is no problem in the production technology, and the quality of soy sauce produced reaches the standard level of the Thailand Industrial Standard Institute (TISI).

Regarding the financial analysis of small industrial scale of soy sauce production capacity of 100,000 litres per year, it shows that good profit can be expected. For the economic analysis, the internal rate of return of this project is 26.56 per cent.

It can be concluded that this project is feasible to invest. - Authors.

81-83/639

SUYANANDANA, Puangpen and FOOTRAKUL, Praphaisri. Improvement of the processing method for disposable facial towel. (การปรับปรุงกรรมวิธีผลิตผ้าเย็น) Rep. no. 1 on Class. Invest. no. 26-04, 1983, 11p. (In Thai.) *CONFIDENTIAL.*

Key Words: Disposable facial towels, Facial towels.

Improvement of the processing method of "Disposable Facial Towel" was carried out by modification of the soaking chemical fluid. Dry heat treatment of the untreated cloth was performed to curb the growth of microorganisms which virtually depreciate the quality of the finished products. Also the microbiological quality controls of the "Disposable Facial Towel" stored at room temperature were checked during the two-month period. - Authors.

Metallurgical & Ceramic Engineering Lab.

81-83/640

CHOTIMONGKOL, Ladawal, SUMPATCHALIT, Thongchai and CHERDCHAI, Kunnika. Survey of the ceramic industry in Thailand. (การสำรวจอุตสาหกรรมเซรามิกในประเทศไทย) Rep. no. 3 on Res. Proj. 25-08, 1983, 50p. (In Thai.)

Key Words: Ceramic industry, Survey.

Survey of the problems and the needs of ceramic industries in Thailand had been conducted in 1982 by TISTR's team of scientists, engineers and economists in order to find out the main requirement which would help TISTR set up projects and consultancy in the future.

The team sent out a seven-page questionnaire to one hundred selected companies and factories, and thirty per cent of them had been visited on site.

The main problems are the fluctuating quality and the sources of raw materials, the high tax charge and the lack of technical know-how which cause low quality products. Marketing is also in high competition among themselves with the same unsuitable pattern with that of the other countries.

Since many small factories concern only their productions and have no knowledge of foreign market, free consultancy with government's experts is recommended. - Author.

81-83/641

SUKAPADDHI, Narong, JUDABONG, Soravuth and CHERDCHAI, Kannika. Survey of the demand for research in foundry industry. (การสำรวจความต้องการงานวิจัยในอุตสาหกรรมการหล่อโลหะ) Rep. no. 1 on Res. Proj. no. 25-03, 1983, 37p. (In Thai.)

Key Words: Foundry industry, Survey.

This report deals with employment condition and general product process of foundry factories, relevant statistics

and major problems as encountered in these factories. Data were compiled on the basis of government agencies reports, technical meetings and results obtained by sending direct questionnaires.

Considering the pattern of problems as indicated in this study foundry factories may be divided into 2 groups:

The first group, consisting of small size foundries, included those of grey cast iron and non-ferrous foundries. The major problems facing these foundries were: low quality of products since there was no standard specification for grey cast iron. Other related problems corresponded to high competition prices of raw materials such as coke and ingot, irregular employment and lack of technical know-how.

The second group covering medium size foundries such as cast steel. The problems observed were: lack of technical know-how and experience in upgrading the quality of products to meet the standard specification, price competition and irregular employment. - Authors.

81-83/642

SUKAPADDHI, Narong, JUDABONG, Soravuth, EMMOSL, Vichian, CHULLARERK, Pisut and KAMESAK, Damrong. Impact testing machine. (การสร้างเครื่องทดสอบแรงกระแทก) Rep. no. 1 on Class. Invest. no. 24-12, 1982, 18p. (In Thai,) CONFIDENTIAL.

Key Words: Test equipment, Impact tests.

Metallurgical and Ceramic Engineering Laboratory has designed and constructed an impact testing machine for iron and steel samples to conform with the requirement as specified by the International Standard Organization (ISO). The advantage of this machine is that it can perform two types of impact testing namely Charpy and Izod methods by using safety and control lever systems in order to obtain the impact energy at 30 kg-m and 17 kg-m respectively. - Authors.

81-83/643
SUMPATCHALIT, Thongchai and SUKHAPADDHI, Narong. Exploitation of tungsten ores. Appr. Rep. no. 34, 1983, 30p.

Key Words: Tungsten, Mining.

The general outlook of tungsten ores have been reviewed showing its strategic role, characteristics, world production and usage, Thailand import/export figures and principal uses of tungsten by-products.

The typical manufacturing process of tungsten and tungsten carbide starting from raw ore has been illustrated based on the production plant in some developed countries.

At TISTR's laboratory, Thai tungsten ores, wolframite and scheelite have been investigated and converted successfully into tungsten trioxide (WO_3) as can be confirmed by the X-ray diffraction analysis of the obtained oxide powder. As this report is part of an extractive metallurgical

industrial research in the country which is only a preliminary attempt, further investigation beyond laboratory scale i.e. pilot plant to enhance feasibility study of establishing of tungsten production plant in Thailand is strongly recommended. - Authors.

Fibre Technology Lab.

81-83/644

ASAVAPIYANOND, Sombat, CHONGVATANA, Supen and NIYOMWAN, Naiyana. Improvement of handmade papermaking. (การปรับปรุงกรรมวิธีการผลิตกระดาษสาของ วท.) Rep. no. 3 on Res. Proj. no. 22-04, 1983, 20p. (In Thai.)

Key Words: Hand-made paper, Po-sa, *Broussonetia papyrifera*, Paper making.

Handmade papermaking in the northern part of Thailand is performed as industry which is limited in the number of producer and consumer. This is the reason why the quality of handmade paper in Thailand has never been improved up to the standard level. Thailand has a lot of handmade paper raw materials known as Po-sa which is grown widely all over the country and is dense in the north and north-east. The quality improvement of Po-sa paper is not too difficult. This project was done by using the information from both local and oversea sources to develop a production process in order to establish

the suitable home industry for the rural area. The processing steps and the lay-out of all necessary equipments for developing this project were shown in this report including a sample of Po-sa paper. - Authors.

81-83/645

ASAVAPIYANOND, Sombat, CHONGVATANA, Supen, HANJANGSIT, Likit, KAMOLRATANAKUL, Anchalee and NIYOMWAN, Naiyana. Design and cost estimation of handmade paper equipments. (การออกแบบและประเมินราคาสร้างเครื่องมือผลิตกระดาษสา) Rep. no. 1 on Class. Invest. no. 26-09, 1983, 12p. (In Thai.) CONFIDENTIAL.

Key Words: Po-sa, *Broussonetia papyrifera*, Hand-made paper, *Hibiscus sabdariffa*, Equipments, Paper making.

This study is part of the joint research project on "Design and Building Equipment for Development of Handmade Paper-making". The target of the study is to design and estimate the cost of building beater and paper-making equipment. The study was made on the basis of modified technical data from different foreign sources along with information derived from an evaluation on the efficiency of the equipment based on a series of experiments conducted by the Fibre Technology Laboratory. The capacity of the beater is 3 kg per hour of

oven-dried bleached pulp. The cost of this beater is approximately 10,000 baht. The size of paper-making frame and screen is 48 by 60 cm. The estimated cost is 500 baht.

Laboratory experiments to ascertain the deficiency of the equipments started from pulping the paper-mulberry fibre by soda process, using 15% NaOH on dry basis. Liquor to wood ratio was found to be 10 to 1. Cooking temperature corresponded to 100°C, cooking time being 5 hr. Pulping yield was 54%. The pulp has a permanganate number of 5.4. Single bleaching was done to the cooked pulp by sodium hypochlorite with a chlorine requirement of 4% on dry basis. Pulp consistency was 6%. Bleaching temperature was 40°C, bleaching time being 3 hr. Bleached pulp was then beaten by a Niagara beater. Paper-making began by dispersing the bleached pulp into the water using the mucilage from *Hibiscus sabdariffa* fruit to help with the pulp dispersion for uniformity of fibre distribution. Then by applying paper-making equipment which was designed and made in the laboratory, the wet sheet was formed and peeled off for further drying process. - Authors.

81-83/646

ASAVAPIYANOND, Sombat, KAMOLRATANAKUL, Anchalee, HANJANGSIT, Likit and NIYOMWAN, Naiyana. Evaluation of the quantity of cotton products in warehouse before the fire incident. (การประเมินปริมาณของสินค้าฝ้ายก่อนถูกไฟไหม้) Rep. no. 1 on Class. Invest. no. 25-17, 1982, 32p. (In Thai.) CONFIDENTIAL.

Key Words: Cotton, Fire damage, Storage.

The Thailand Institute of Scientific and Technological Research has carried out this research project by surveying and analyzing the burnt products using both volumetric and chemical methods to evaluate the least quantity of each kind of cotton products. The results have shown that originally at least there were 670 bales of the cotton before the blaze. The evaluation for cotton bale is based only on volumetric analysis because the ash content in cotton bale was contaminated by other foreign matters so that it was not representative. The least quantity of cone yarn before burning by volumetric, ash content, and CaO content were estimated at 116,506, 219,328, and 202,210 kg, respectively. The corresponding figures of bundle yarn were 127,727, 348,793, and 403,913 kg. It has been revealed that the estimate by volumetric analysis was much less than by chemical analysis. This was due mainly to the fact that there were some loss in the damaged products from the complete burning process which cannot be ascertained. The ash content was, however, stable after complete burning. Thus the evaluation by chemical analysis

should be regarded as more accurate than by volumetric analysis. - Authors.

81-83/647

KAMOLRATANAKUL, Anchalee, KAMOLRATANAKUL, Nipon, NIYOMWAN, Naiyana, BUSAYASAKUL, Naronchai, SUVACHITTANONT, Sirikalaya, OPANONOMATA, Wattana and CHAVADEJ, Sumaeth. Pre-feasibility study on a small-scale bagasse pulp and paper mill. Rep. no. 1 on Res. Proj. no. 23-01, 1982, 61p.

Key Words: Bagasse, Pulp mills, Paper industry.

The study has revealed that it is economically feasible to invest in the establishment of a samll-scale mill to produce pulp and paper from bagasse in the precinct of sugar producing area. The mill with a capacity of 20 od t/day bleached bagasse pulp and 30 ad t/day printing and writing paper was used as a basis for the study.

The total capital investment of the proposed project was estimated at 260 million baht which can be classified as follows:

Total capital investment	260 million baht
- Fixed assets	230 million baht
- Working capital	17 million baht
- Pre-operating expenses (included start-up expenses)	13 million baht

A cash flow statement was prepared to evaluate the expected profitability of the project during the initial ten years of operation. As a percentage of total investment, the average rate of return came to 17.0%. - Authors.

81-83/648

KAMOLRATANAKUL, Anchalee, NIYOMWAN, Naiyana and SUVACHITTANONT, Sirikalaya. Oxygen pulping of kenaf and oxygen bleaching of kenaf pulp. (การพัฒนากรรมวิธีผลิตเยื่อเคมีจากปอแก้วแบบไม่ทิ้งไม่เป็นพิษ) Rep. no. 4 on Res. Proj. no. 22-04, 1983, 29p. (In Thai.)

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Key Words: Kenaf, Pulp industry, Oxygen process.

This report presents a preliminary study on the oxygen pulping of Thai kenaf and the oxygen bleaching of unbleached soda and sulphate kenaf pulp.

The single stage soda-oxygen pulping of Thai kenaf stalk was investigated at constant alkali charge, temperature ranging from 120 to 150°C and oxygen pressure ranging from 0 to 140 psi. The results show that bright pulp could be obtained with moderate strength properties at oxygen pressure 140 psi and temperature levels of 130 to 140°C.

The oxygen bleaching experiment was made on unbleached soda and sulphate kenaf pulp. The results indicate that the oxygen stage could replace conventional chlorination bleaching. The oxygen bleached pulp has comparable brightness and properties to that bleached by chlorine sequence. The optimum con-

dition for oxygen stage bleaching was obtained at oxygen pressure 160 psi., temperature 130°C and 30 minutes bleaching time. The acid pretreatment by 2% sulphuric acid solution at room temperature for 5 minutes satisfactorily improve brightness of the pulp. - Authors.

81-83/649

NIYOMWAN, Naiyana, KAMOLRATANAKUL, Anchalee, HANJANGSIT, Likit, TANVIRACHAISAKUL, Visha and TACHASAEN, Tanes. Techno-economic survey on demand for research on pulp and paper industries. (การสำรวจและศึกษาความต้องการงานวิจัยในอุตสาหกรรมเยื่อกระดาษและกระดาษ) Rep. no. 2 on Res. Proj. no. 25-08, 1983, 55p. (In Thai.)

Key Words: Pulp industry, Paper industry, Techno-economic survey.

Results of the survey indicated that there were several problems deterring the progress of pulp and paper industries in Thailand. The degree of problems varied according to the size of industries.

Most industries needed research service, particularly in technical know-how and processing methods. Detailed recommendations and research findings useful in solving the problems encountered in pulp and paper industries are included in this report. - Authors.

81-83/650

NIYOMWAN, Naiyana, OPANONOMATA, Wattana, BUSAYASAKUL, Naronchai, SUVACHITTANONT, Sirikalaya and KAMOLRATANAKUL, Anchalee. Production of bagasse pulp by magnesium bisulphite process. (การศึกษาการผลิตเยื่อกระดาษจากกากอ้อยด้วยกรรมวิธีแมกนีเซียมไบซัลไฟท์) Rep. no. 2 on Res. Proj. no. 21-26, 1981, 13p. (In Thai.)

Key Words: Pulps, Paper industry, Bagasse, Sulfite pulping.

This research project was financed by the Siam Cement Foundation to study the production of bagasse pulp by magnephite process. This is the second report, following the first, which shows that the one-stage magnephite cooking of bagasse at temperature of 150°C for 3 hours gave better results than two-stage magnephite cooking by impregnation at 115°C for 1 hour and at 150°C for 3 more hours. Thus this study is intended to find the optimum condition of cooking at 150°C, by having as variable, the cooking time, the liquor/wood ratio and the percentage of SO_2 in cooking solution. Furthermore, the report also compares the properties of the bagasse pulp obtained with that derived from other chemical thermomechanical and chemi-thermomechanical processes. - Authors.

81-83/651

NIYOMWAN, Naiyana, OPANONOMATA, Wattana, SUVACHITTANONT, Sirikalaya, KAMOLRATANAKUL, Anchalee and ASAVAPIYANOND, Sombat. Utilization of Po-sa in pulp industry. (การใช้ประโยชน์ไม้ปอสาในอุตสาหกรรมเยื่อกระดาษ) Rep. no. 2 on Res. Proj. no. 22-04, 1983,

14p. (In Thai.)

Key Words: *Broussonetia papyrifera* Vent, Po-sa, Pulp industry, Hand-made paper, Paper making.

Using "Po-sa" (*Broussonetia papyrifera* Vent.) for making hand-made paper has been practised for centuries. Hand-made paper in Japan is so well developed that its quality is much better than Thai "Po-sa" hand-made paper. In Thailand "Po-sa" paper making is performed as a home industry especially of the people in the North, using only tree bark as raw material. "Po-sa" tree is naturally fast growing and is found in almost every part throughout the country. Due to its long fibre bark and white woody core, an effort should be made to utilize Po-sa in pulp industry. This study is a preliminary investigation of chemical pulp production from Po-sa. The proportion of "Po-sa" bark to its stem is approximately 1 to 8 in weight. In making hand-made paper, a great quantity of the Po-sa woody core is wasted. Utilization of the whole stem of "Po-sa" plant means making full use of the tree. The results of this investigation indicate that there is a promising trend for "Po-sa" tree to be fully used for chemical pulp production. Thus further studies on the utilization of Po-sa for pulp industry should greatly be encouraged. - Authors.

81-83/652

NIYOMWAN, Naiyana, SUVACHITTANONT, Sirikalaya, ASAVAPIYANOND, Sombat, OPANONOMATA, Wattana and DISYABOOT, Pornsawan. Production of absorbent cotton wool. (การผลิตสำลีชั้น) Rep. no. 1 on

Class. Invest. no. 23-09, 1981, 36p. (In Thai.) CONFIDENTIAL.

Key Words: Absorbers (materials), Cotton fibres.

Contract Research on Production of Absorbent Cotton Wool for the Besy Aron Co., Ltd. was conducted by the Thailand Institute of Scientific and Technological Research. The objective of this project is to carry out a study on the production processes of absorbent cotton wool from local raw material in order that the products met the standard of USP. This study includes fibre analysis, cleaning of raw material, scouring, bleaching and property testing of the products obtained. Furthermore, comparison is made of the properties of commercial products sold by the company and of cotton wool obtained from the Textile Organization to that derived from the sample on the basis of Standard Industrial Products of Thailand. The results of the study have shown that there is high potential for processing absorbent cotton wool from local raw material to the effect that the products meet the standard requirement. - Authors.

81-83/653

NIYOMWAN, Naiyana, SUVACHITTANONT, Sirikalaya, OPANONOMATA, Wattana, KAMOLRATANAKUL, Anchalee and BUSAYASAKUL, Naronchai. Utilization of kenaf ribbon and kenaf woody core in pulp industry. (การศึกษาความเหมาะสมในการแยกใช้ประโยชน์จากเปลือกปอ (ปอกลีบ)

และแกนปอในอุตสาหกรรมเยื่อกระดาษ) Rep. no. 1 on Class. Invest. no. 21-13, 1981, 19p. (In Thai.) CONFIDENTIAL.

Key Words: Kenaf, Pulp industry, Paper industry.

Mechanical decortication was applied to kenaf, both fresh and dry stalks, to get kenaf ribbons and kenaf woody cores for chemical pulping. The results showed that the quality of pulp made from kenaf ribbons was higher than that from kenaf whole stalks, especially ribbons from fresh stalks. The chemical pulp from kenaf woody cores possessed a quality corresponding to the other domestically produced short-fibre pulps. These data are very useful for paper industry because if a distinction can be made to differentiate the quality of pulp, long or short-fibre, as high, medium and low, this would facilitate the selection of fibre pulp in suitable proportions for the production of paper pulp in accordance with the requirement. The study has also indicated that the fibre loss due to the mechanical decortication was insignificant. Taking into consideration the capacity together with the cost of mechanical decortication, handling, transportation and storage of kenaf in the form of ribbons and woody cores is more than counterbalanced the transportation and storage cost which is to a certain extent more convenient and economical. Furthermore, the chemical consumption of pulping of kenaf ribbons were less than that of kenaf whole stalks. This would account for less production cost. The benefit gained from the above study would serve as a guideline for proper planning in relation

to procurement, transportation, handling and storage of raw materials for the kenaf fibre pulp industry. - Authors.

81-83/654

SUVACHITTANONT, Sirikalaya, NIYOMWAN, Naiyana and KAMOLRATANAKUL, Anchalee. Bagasse as a raw material for pulping. (การศึกษาวิจัยเปรียบเทียบคุณสมบัติของกากอ้อยที่ใช้เป็นวัตถุดิบในการผลิตเยื่อกระดาษ) Rep. no. 1 on Res. Proj. no. 22-04, 1983, 48p. (In Thai.)

Key Words: Bagasse, Pulp industry, Paper industry.

The aim of this project is to compare the physical properties of bagasse pulp from Suphan Buri, Ratchaburi, Chon Buri and Kanchanaburi by applying alkaline sulphite and soda processes which are currently being used by pulp and paper industries in Thailand. Results from this experiment showed that bagasse from Suphan Buri was the best quality type, while for those from other provinces the corresponding results on bagasse properties were described as in the following descending order: from Ratchaburi, Chon Buri and Kanchanaburi. In general bagasse quality depends on two main factors, i.e. sugar cane quality and refinery which produces bagasse as a by-product. - Authors.

Chemical & Process Engineering Lab.

81-83/655

EUR-AREE, Ampon, VIMOLCHALAO, Chote, ARUNYANAK, Silpachai,

NUMCHAISEWATANA, Sakdo, TUNVIRACHAISAKUL, Visha and NEAMPREM, Tamrong. The pre-feasibility study on the production of raw material from glue stock for use in animal feed industry. (การศึกษาความเหมาะสมเบื้องต้นของการผลิตวัตถุดิบเพื่อใช้ในอุตสาหกรรมอาหารสัตว์จากเศษหนังกาว) Rep. no. 1 on Class. Invest. no. 24-07, 1981, 81p. (In Thai.) CONFIDENTIAL.

Key Words: Feeds, Glue stock, Waste utilization.

This research contract has been awarded to the Thailand Institute of Scientific and Technological Research by Tanning Organization. The purpose of this project is to study the pre-feasibility of processing animal feed from glue stock. The production of glue stock approximately 6.9 tons per day, were supplied as raw material to the plant with a capacity of 1,000 kg/hr.

Experimental results on a pilot scale have shown that the product which can be used as composition of animal feed, contained approximately 70% crude protein, which constituted 10% of the production of glue stock, and yielded a by-product (raw grease) of the same amount.

The pilot plant, considering the quantity of glue stock found in Tanning Organization's Factory, produced approximately 6.9 ton/day. Thus, a plant with a capacity of 1,000 kg/hr is suitable for this purpose. This would produce roughly 100 kg/hr each of protein and raw grease. Raw grease can be used for oil bleaching in the tanning process.

From above, it can be concluded that expensive machinery increased the cost of production to a high while the rate of return was rather low. This makes investment on the project unfavourable. - Authors.

81-83/656

STEVENS, John, SUKAPADDHI, Narong and CHULLARERK, Pisut. The technical feasibility of using ethyl alcohol in one-cylinder diesel engines. Rep. no. 1 on Res. Proj. no. 24-10, 1981, 8p.

Key Words: Alcohols, Fuels, Diesel engines, Ethyl alcohol, Ethanols.

This project attempts to study the possibility of substituting alcohol for part of the diesel fuel in a conventional one-cylinder diesel engine, and then comparing the performance in two modes of application, namely a water pump and a cassava chipping machine. The technique as developed is to inject the alcohol into the intake manifold by a carburetting system. It has been found that the diesel fuel consumption can be reduced ranging from 52 to 75 per cent depending on the engine's application. However the amount of alcohol replacing the diesel fuel may be in excess to expectations showing inefficiency in combustion. - Authors.

81-83/657

VIMOLCHALAO, Chote, ASAVAPIYANOND, Sombat and EUR-AREE, Ampon. Survey of process machinery and equipment manufacturers for industries in Thailand. (การสำรวจและรวบรวมโรงงานผลิตเครื่องจักร

และส่วนประกอบเพื่อโรงงานอุตสาหกรรม) Rep. no. 5 on Res. Proj. no. 25-08, 1983, 25p. (In Thai.)

Key Words: Machinery, Equipments, Industrial plants.

Process machinery and equipment are classified into 31 items as shown in the process machinery and equipment content. Only a few manufacturers produce specific kinds of machinery and equipment such as cassava flour plant, packaging machines, plastic products and so on. However, most of them produce machinery and equipment by blue prints. Small manufacturers with 5-20 workers add up to 44.7% of the total manufacturers as shown in this report. - Authors.

81-83/658.

VIMOLCHALAO, Chote, SUKAPADDHI, Narong and MUNSAKUL, Supatra. Preliminary study on the dolomite calcination to separate magnesium oxide using steam as a catalyst. (การศึกษาเบื้องต้นของการเผาแมกนีเซียมออกไซด์จากแร่โดโลไมท์โดยใช้ไอน้ำเป็นตัวเร่งปฏิกิริยา) Rep. no. 1 on Res. Proj. no. 21-27, 1981, 17p. (In Thai.)

Key Words: Dolomite (mineral), Magnesium oxide.

This is the result of an initial attempt to investigate the processing technique of calcination of dolomitic minerals by a rotary kiln at the subcritical transformation temperature (below 800°C) by using steam as a catalyst.

The X-ray diffraction technique (CoK_{α} radiation λ = 1.79°A) was used to detect the phase transformation of crystal structure of dolomite samples, which calcined at the temperature ranging from 500 to 700°C for different retention times 1 to 8 hr. It has been revealed that at this temperature range there was a peak at 50.30° which is a diffraction line from the plane (2.00) of spacing d_{200} = 2.11°A of MgO, has very low intensity. This experiment has indicated that the steam has a slight effect, at this kiln temperature and duration of retention time, on the $MgCO_3$, as found in the complex compound of $CaMg(CO_3)_2$, which decomposed. - Authors.

Oils & Fats Lab.

81-83/659

ARUNYANAK, Silpachai and MUNSAKUL, Supatra. Study on the process of supple shell products. (ศึกษากรรมวิธีการทำผลิตภัณฑ์เปลือกหอยอ่อนตัว) Rep. no. 2 on Class. Invest. no. 23-06, 1981, 16p. (In Thai.) CONFIDENTIAL.

Key Words: Ornamental shells.

The purpose of this investigation is to find the suitable condition and process for the preparation of capiz shells for laminated products. - Authors.

81-83/660

ARUNYANAK, Silpachai, JENVANITPANJAKUL, Peesamai, VIMOLCHALAO, Chote and MUNSAKUL, Supatra. Quality improvement of methyl salicylate. (การปรับปรุงคุณภาพของน้ำมันระกำ) Rep. no. 1 on Class. Invest. no. 24-06, 1981, 7p. (In Thai.) *CONFIDENTIAL.*

Key Words: Methyl salicylate.

A research project on the quality improvement of 9.6 tons of methyl salicylate was carried out by distilling under reduced pressure. The properties of the improved oil correspond to the USP standard. - Authors.

81-83/661

ARUNYANAK, Silpachai, STHAPITANONDA, Kannika and MUNSAKUL, Supatra. Preparation of varnish from Cashew Nut Shell Liquid on semi-pilot scale. (การทำวาร์นิชจากน้ำมันคิบจากเปลือกเมล็ดมะม่วงหิมพานต์ ในระดับกึ่งโรงงานต้นแบบ) Rep. no. 1 on Class. Invest. no. 23-21, 1981, 23p. (In Thai.) *CONFIDENTIAL.*

Key Words: Cashew Nut Shell Liquid, Varnishes.

Cashew Nut Shell Liquid (CNSL) can be used in producing varnish by mixing with paraformaldehyde and diethylenetriamine in closed vessel. The mixture was heated in 1 hour at 100-110°C then cooled down and thinned with xylene. Consequently, high viscous liquid in dark brown colour was obtained.

After mixing with driers, the product became quick drying varnish which is resistant to water and alcohol solution. The varnish is suitable for wood-coating. The previous report on "Preparation of varnish from Cashew Nut Shell Liquid on laboratory scale" was used as a guideline for this experiment. - Authors.

81-83/662

BHUNTUMKOMOL, Kesara and MUNSAKUL, Supatra. Investigation of production of phenol-formaldehyde resin from peanut shell on laboratory scale. (การวิจัยการผลิตกาวเรซินจากเปลือกถั่วลิสงในระดับห้องปฏิบัติการ) Rep. no. 1 on Class. Invest. no. 25-20, 1983, 16p. (In Thai.) CONFIDENTIAL.

Key Words: Resin, Waste utilization, Peanut shell.

Phenol-formaldehyde resin used in producing particle board was prepared from peanut shell extract, phenol and formalin solutions at a temperature not exceeding 80°C. This will reduce the amount of phenol normally used by 40%. The cost of raw materials (peanut shells and chemicals) was calculated at 66 baht per kg of resin produced. The electricity used for heating was estimated at approximately 6 kW-hr per kg of resin produced. - Authors.

81-83/663

JENVANITPANJAKUL, Peesamai and MUNSAKUL, Supatra. Study on the bleaching process of capiz shells. (ศึกษากระบวนการฟอกเปลือกหอยกระจก) Rep. no. 1 on Class. Invest. no. 23-06, 1981, 23p. (In Thai.) *CONFIDENTIAL.*

Key Words: Ornamental shells.

Capiz shells which are supplied for the cottage industry in the country are usually scoured by grindstones. In some cases they may be bleached by using hydrochloric acid. The bleached shells are white opaque and unglossy. This results in low quality and poor appearance of the derived products. For this reason, this investigation is aimed at exploring the possibility of a suitable process for bleaching capiz shells in such a way as to obtain white, translucent, glossy and thin articles.

Sodium hypochlorite, hydrochloric acid and hydrochloric - formic acids were chosen as bleaching chemicals. The comparison of these three chemicals was made considering the fact that the process was uncomplicated and involved no pollution. It was concluded that hydrochloric - formic acid were the suitable chemicals. The properties of the obtained shells were found to comply with the required standard. - Authors.

81-83/664

JENVANITPANJAKUL, Peesamai, SRIVICHIT, Decho, SIRIPONGSAROJ, Kriangsak and MUNSAKUL, Supatra. Vegetable oils as fuel for diesel engines. (การใช้น้ำมันพืชเป็นเชื้อเพลิงในเครื่องยนต์ดีเซล) Rep. no. 2 on Res. Proj. no. 24-16, 1982, 32p. (In Thai.)

Key Words: Vegetable oils, Fuels, Diesel engines, Curcas oil, Coconut oil, Peanut oil.

A study was made on the use of vegetable oils as diesel fuels in 7 hp 1 cylinder diesel engines. The test engines were of the nozzle type which applies direct injection with no modifications. The vegetable fuels used consisted of crude curcas, coconut, peanut, refined peanut oil, oil blend of 40% crude peanut oil with diesel oil, and oil blend of 50% crude peanut oil with kerosine and palm ester.

Comparisons of short-term engine performances by using vegetable and diesel oil were made. Results showed that the torque on vegetable fuels equalled or were close in value to that on diesel oil. Fuel consumption on crude curcas, coconut, peanut, refined peanut oil, oil blend of 40% crude peanut oil with diesel oil, and palm ester were 12.4, 21.2, 6.2, 11.5, 13.3, and 8% respectively higher than that on diesel oil; but consumption on oil blend of 50% crude peanut oil with kerosine was 4.4% lower than that on diesel oil. - Authors.

81-83/665

JENVANITPANJAKUL, Peesamai, STHAPITANONDA, Kannika and MUNSAKUL, Supatra. Preliminary study on curcas oil. (การศึกษาคุณสมบัติเบื้องต้นของน้ำมันเมล็ดสบู่ดำ) Rep. no. 1 on Res. Proj. no. 24-16, 1981, 8p. (In Thai.)

Key Words: Physic nut, *Jatropha curcas*, Fuels, Renewable energy, Curcas oil, Vegetable oils.

A physic nut yielded an oil content of 33.5% seed weight, or 52.8% kernel weight. The physico-chemical properties of curcas oil, including the composition of the main fatty acids, were shown in the report. Fatty acids consisted of 14.87% palmitic, 5.99% stearic, 41.19% oleic and 37.38% linoleic. The heating value of the oil corresponded to 16,780 Btu per pound of oil. The sulphur content was 0.3%. There is a possibility for curcas oil to become alternative energy to replace diesel oil especially in applying with water pumps, generators and labour-saving agricultural machinery. The de-oiled seed-cakes containing 4.25% N, 1.88% P_2O_5 and 1.51% K_2O can be well used as manure. - Authors.

81-83/666

JENVANITPANJAKUL, Peesamai, WORASUMUN, Sarawat, SINCHAISRI, Cheumsakra, YENYING, Amonsak and MUNSAKUL, Supatra. Peanut oil as fuel in diesel engines. (การใช้น้ำมันถั่วลิสงแทนน้ำมันดีเซลกับเครื่องยนต์ดีเซล) Rep. no. 1 on Class. Invest. no. 23-03, 1981, 15p. (In Thai.) CONFIDENTIAL.

Key Words: Peanut, Vegetable oils, Fuels, Diesel engines, Renewable energy.

The study on using peanut oil as fuel in diesel engines without altering any part of the engine was carried out. The results showed that the engines, using either peanut or diesel oil as fuel, exerted the same power efficiency. The engine using peanut oil consumed more fuel. Furthermore, it was difficult to start the engine and there was also a non-smooth running at low speed. -- Authors.

81-83/667

NUTALAYA, Kesara, SRIKUMLAITHONG, Sumalai, ARUNYANAK, Silapachai, JENVANITPANJAKUL, Peesamai, STHAPITANONDA, Kannika, RAMANVONGSE, Sunanta, SIRIPONGSAROJ, Kriangsak, PIYAPONGSE, Sachee and MUNSAKUL, Supatra. Survey on status and constraints of vegetable oil industry. (การสำรวจสภาวะการณ์และปัญหาอุตสาหกรรมน้ำมันพืช) Rep., no. 4 on Res. Proj. no. 25-08, 1983, 64p. (In Thai.)

Key Words: Vegetable oil industry.

This report informs about the survey and study on the vegetable oil and fat industry status in 1982, which data are based on the questionnaires received from 17% of the total number of oil and fat plants in Thailand. Other data were collected from many information centers and also from the surveys and observations of a few vegetable oil factories around. The report covers various topics such as production and market-

ing status of vegetable oils, roles and policies stated by the government on the vegetable oil industries, status and problems of vegetable oil manufacturing, etc.

From the surveys, it can be concluded that even vegetable oil industries have been evolving for more than 20 years, they still mostly confront with raw material problems in both quantity and quality points. Besides, small scale oil plants meet also processing problems such as low efficiency manufacturing, low quality products and non-appropriate quality control. Other minor problems are such as management and marketing problems on both raw materials and oil product competitions. All these stated problems result in low production of vegetable oil plants when compared to their real capacity at present. In order to solve the problems and eliminate those barriers in vegetable oil processing, TISTR concluded in this report the approaches and opportunities to develop the research works in the following areas : research on raw materials, research on oil processing and research on marketing. - Authors.

81-83/668

RAMANVONGSE, Sunanta and MUNSAKUL, Supatra. Development of the production process of non-refined, edible-grade coconut oil. (การปรับปรุงวิธีการผลิตน้ำมันมะพร้าวสำหรับบริโภคชนิดธรรมชาติ) Rep. no. 1 on Res. Proj. no. 23-15, 1981, 24p. (In Thai.)

Key Words: Coconut oil, Vegetable oils.

Non-refined edible-grade coconut oil could be produced from fresh coconut meats containing an initial moisture content of 48 per cent. The fresh should be slidden off into fibres and dried in the sun (temperature 37-40°C) or by electric oven (temperature 60°C) to obtain 2-3% moisture content before processing.

The oil obtained from unstored dried and shredded coconut was colourless and yielded a specific coconut odour. It possessed however properties which conforms to the standard specifications. It can be kept in colsed-bottles at room temperature of more than 3 months without changing colour, smell and properties; and hence there is no need to apply antioxidant. From the coconut stored for one month can be produced standard edible grade oil and can be kept for 3 months further. The coconut kept longer than two months had a very strong rancid smell and hence yielded rancid oil which is not up to the standard. Producing oil on a semi-pilot scale using 180 kg of raw material and a 15 hp expeller, the coconut should be kept no longer than 15 days in order to obtain high grade oil. It follows that lower grade oil will be obtained from the coconut stored for one month. If the storage time is longer than one month, the derived oil will have to undergo refining and deodorizing processes. The oil obtained from the 1 month storage raw-materials was in the lower grade.

Hydraulic press and expeller can both be used for producing oil which yielded approximately the same oil content, averaging 49.8 and 50.5% respectively. The defatted cake ob-

tained still contained an oil content of 8-26, 12 and 40-43% for oil, protein and carbohydrate respectively. - Authors.

81-83/669

RAMANVONGSE, Sunanta and MUNSAKUL, Supatra. Preparation of krabok seed fat for edible use : on laboratory scale. (การเตรียมไขมันจากเมล็ดกระบกสำหรับบริโภคในขั้นห้องปฏิบัติการ) Rep. no. 2 on Res. Proj. no. 21-21, 1981, 19p. (In Thai.)

Key Words: Krabok, Vegetable oils, *Irvingia malayana*.

Krabok fat, which is obtained by hexane extraction, after passing through the refining process such as neutralization, decolourization and deodorization, is termed "refined krabok fat". This can be processed into best quality cooking oil and as liquid oil at room temperature ($30^{o}C$). It has been revealed that the resulted oil, derived by mixing refined krabok fat with refined soybean oil at the proportions of 2:8 and 1:9 was higher in nutritional value than was the original fat. The percentage of unsaturated fatty acids content in it increased. The physico-chemical characteristics of the oil were within the standard specification for edible oil. Storage tests have shown that it could be kept in liquid form at $30^{o}C$ for 12 months (maximum storage time). Krabok fat can also be modified into powder by using drum drier and spray drier to obtain 78 and 66% yields respectively. - Authors.

81-83/670

RAMANVONGSE, Sunanta, ASA, Somnuk and MUNSAKUL, Supatra. Formulation of liquid soap. (การวิจัยผลิตน้ำสบู่เหลว) Rep. no. 1 on Class. Invest. no. 26-05, 1983, 10p. (In Thai.) CONFIDENTIAL.

Key Words: Liquid soap.

The experiments on formulation of body liquid soap were carried out using various formulas and chemicals. The suitable formula had been selected. The liquid soap thus obtained approximated that of the sample in property. The cost of raw material for the production of liquid soap excluding electricity, water, and labour cost is 75.60 baht per kilogram. - Authors.

81-83/671

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. The adjustment of moisture content of peanut. (การปรับความชื้นของเมล็ดถั่วลิสง) Rep. no. 1 on Class. Invest. no. 24-04, 1981, 5p. (In Thai.) CONFIDENTIAL.

Key Words: Peanut, Aflatoxin, Moisture content.

81-83/672

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. The production of activated clay on laboratory scale. (การผลิตดินฟอกสีในขั้นห้องปฏิบัติการ) Rep. no. 1 on Class. Invest. no. 24-21, 1981, 4p.

(In Thai.) CONFIDENTIAL.

Key Words: Activated clay, Kapok oil, Vegetable oils.

The clay was processed to produce activated clay for vegetable oil industry. - Authors.

81-83/673

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. The production of activated clay on laboratory scale. (การผลิตดินฟอกสีในขั้นห้องปฏิบัติการ) Rep. no. 1 on Class. Invest. no. 25-25, 1982, 3p. (In Thai.) CONFIDENTIAL.

Key Words: Activated clay, Vegetable oils.

The clay was processed to produce activated clay for vegetable oil industry. - Authors.

81-83/674

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. The properties of palm stearin. (คุณสมบัติของไขมันปาล์มสเตียริน) Rep. no. 1 on Class. Invest. no. 26-19, 1983, 5p. (In Thai.) CONFIDENTIAL.

Key Words: Stearate, Palm oils.

81-83/675

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. The stability test of wax emulsion and dry-bright emulsion. (การอยู่ตัวของสารผสมขี้ผึ้งชนิดเงา) Rep. no. 1 on Class. Invest. no. 24-05. 1981, 3p. (In Thai.) *CONFIDENTIAL.*

Key Words: Emulsions, Varnishes, Wax emulsion, Dry-bright emulsion.

81-83/676

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. Study on aflatoxin in crude vegetable oil and its detoxification. (การศึกษาปริมาณอะฟลาทอกซินในน้ำมันพืชธรรมชาติและการกำจัดสารพิษ) Rep. no. 2 on Res. Proj. no. 23-14, 1982, 10p. (In Thai.)

Key Words: Aflatoxin, Vegetable oils, Detoxification, Coconut oil, Sesame oil.

Aflatoxin was determined in 13 samples of crude coconut oil and 7 samples of crude sesame oil. Aflatoxin content in 2 samples of crude coconut oil was detected to be higher than 20 ppb. This level of aflatoxin was not found in crude sesame oil.

Detoxification of crude coconut oil was successfully achieved in reducing aflatoxin from 25 ppb to nil by stirring the oil with 0.3% of Fuller's earth at the speed of 15 rpm for 15 minutes. After a 6-month storage, the treated and untreated oil showed no significant difference in acid and peroxide value. Two types of Fuller's earth

namely, AAA and Galleon earth, were used for absorbing aflatoxin. Both types indicated no significant difference in reducing the toxin. The detoxification process was highly effective, not complicated and is suitable for small-size coconut oil plants. - Authors.

81-83/677

SRIKUMLAITHONG, Sumalai and MUNSAKUL, Supatra. Utilization of krabao-seed meal. (การใช้ประโยชน์ของกากเมล็ดกระเบา) Rep. no. 2 on Res. Proj. no. 21-16, 1982, 17p. (In Thai.)

Key Words: Krabao, Feeds, *Hydnocarpus anthelmintica*.

Krabao-seed kernel contains 57% oil and 43% meal. The meal is mainly composed of 38% protein and 31% carbohydrate. Krabao-seed protein was extracted by solubilizing with 0.1 N NaOH, and then the solution was adjusted to a series of pH with 5 N NaOH. The maximum solubility of protein was obtained when the pH of the solution was 9.8. Solubilized protein was precipitated by adding 0.1 N HCl. The maximum precipitation occurred at the pH of 5.1, to give yield of 14.6% of dry superconcentrated protein, containing 91.5% protein. The remaining meal after extraction constituting 76% contained 28.8% of the total crude protein.

The quality of krabao protein was estimated from its amino acid composition as compared with the reference pattern of amino acids (egg). It was shown that amino acid score of phenylalanine of krabao-seed meal and superconcen-

trated krabao-seed protein was 145.5 and 150.1% respectively. Krabao-seed meal contained isoleusine and lysine as limiting amino acid, as against isoleusine, lysine and valine for super-concentrated krabao-seed protein.

Investigation on the effect of acute and subchronic toxicity of krabao-seed meal on mice and albino rats were carried out. In case of intraperitoneal injection on mice, toxicity symptom showed. No toxicity symptom was found in mice per oral and in the rats feeded with 20 and 40% of the meal in animal feed for 98 days. - Authors.

81-83/678

SRIKUMLAITHONG, Sumalai, NUMCHAISEWATANA, Sakda, KAMOLRATANAKUL, Nipon, PITAKARNNOP, Nara, JENVANITPANJAKUL, Peesamai and MUNSAKUL, Supatra. The production of activated clay. (การผลิตดินฟอกสี) Rep. no. 1 on Res. Proj. no. 20-37, 1981, 49p. (In Thai.)

Key Words: Activated clay.

Raw clay used to produce activated clay which was obtained from Lop Buri Province, contains calcium montmorillonite. An experiment on a laboratory scale has shown that activation was brought about by heating the clay in suspension with demineralized water and hydrochloric acid at 0.21 gramme of hydrochloric acid concentration per gramme of clay at 90-98°C for 10 hours. The activated clay was tested in decolourizing neutralized soya bean oil which resulted in the

reducing the colour of the oil from 50Y:2.0R to 6Y:0.8R. When the processing time was changed to 5, 8, 10 and 15 hours, the absorbent efficiency had no significant difference. The bleaching clay achieved by activation with 0.20 gramme of sulphuric acid per gramme of clay at 95-98°C for 10 hours gave the same decolourizing power as using hydrochloric acid but its yield was higher.

An experiment on a semi-pilot scale has indicated that activated clay was obtained by heating the mixture of raw clay, soft water and 0.21 gramme of hydrochloric acid per gramme of clay at 87-95°C for 5, 10 and 15 hours in sequential order. The longer the time was consumed the lower the yield was obtained. Activation carried out by digesting clay with dilute sulphuric acid in the proportion of 0.18, 0.36 and 0.72 gramme of sulphuric acid per gramme of clay yielded no significant difference in absorbent efficiency. The lower the acid was used, the higher the yield was obtained, accompanied by better filtration characteristics and more oil yield. The decolourizing power had no significant difference. On the basis of classifying reaction time into 1, 3, 5 and 10 hours and using 0.20 gramme of sulphuric acid per gramme of clay, activation for 1 and 3 hours was found to be inadequate while for 10 hours excessive. On comparing the decolourizing properties, oil retention and filtration characteristics, it has been revealed that the most suitable condition for activated clay was achieved by digesting clay in the aqueous solution of sulphuric acid

at 0.20 gramme of sulphuric acid concentration per gramme of clay at 87-95°C for 5 hours. Under such condition, the process yielded 80% of activated clay, and colour of the oil was reduced from 78Y:3.0R to 8.8Y:1.0R. The filtration time was $1\frac{1}{2}$ minutes at the reduced pressure of 6 inch Hg and yielded an amount of filtrate of 95 per cent.

The acid value of the oil decolourized with the experimented clay was lower than that of the oil bleached with activated clay widely used in the oil industries. The contaminants (Fe, Cu, Pb and As) elements in the decolourized oil were not increased.

The proposed project on activated clay production with a capacity of 2 tons per day of finished product is considered to be a small-scale industry with the total investment of 3.5 million baht. Since there is a great demand in the local market for this product, it is appropriate to promote the establishment of such factory in Thailand. At present the local demand for activated clay approximately 3,000 tons per year is met by import. The study has indicated that producing activated clay locally has many advantages over the imported product. These advantages are in the form of availability of local raw material and cheaper lobour supply which result in lower production cost and hence selling price. The feasibility analysis also showed that the project started to earn profit in the second year of operation. The internal rate of return is about 30 per cent and the pay-back period is 5 years. - Authors.

81-83/679

SRIKUMLAITHONG, Sumalai, SIRIPONGSAROJ, Kriangsak and MUNSAKUL, Supatra. Palm oil industry in Thailand. (อุตสาหกรรมน้ำมันปาล์มในประเทศไทย) Rep. no. 1 on Res. Proj. no. 24-15, 1982, 24p. (In Thai.)

Key Words: Palm oils, Vegetable oils.

The climate in the southern part of Thailand is suitable for planting oil palm. Areas under cultivation increase yearly. At present, there are three palm oil plants which produce oil at the capacity of 10-30 tons per day per factory, but these factories are facing the problem of shortage of oil palm. The local demand for palm oil is projected to increase but the production is insufficient to meet the demand.

The property of crude palm oil obtained from the factory was suitable for industrial use due to the high content of acid value. Palm kernel oil and coconut oil have similar characteristics in terms of their fatty acid content, physical and chemical properties. It may well substitute coconut oil. Apart from the oil, oil palm can be utilized as follows:

1. Ash of oil palm bunch is used as fertilizer due to high content of potash, being as high as 20%.

2. Fruit pulp and seed shell are used as fuel for boiler. The heating value for fruit pulp and seed shell corresponds to 6778 and 8094 Btu/lb gross wt. respectively.

3. Defatted oil palm obtained from small industries is used for animal feed. - Authors.

81-83/630

STHAPITANONDA, Kannika, ARUNYANAK, Silpachai, MUNSAKUL, Supatra and UDOMSAKDI, Bancha. Krabao-seed oil for paint. (การทำสีทาจากน้ำมันเมล็ดกระเบา) Rep. no. 1 on Res. Proj. no. 21-16, 1981, 15p. (In Thai.)

Key Words: Krabao, *Hydnocarpus anthelmintica*, Drying oils, Paints, Vegetable oils.

The processing of drying oil from krabao (*Hydnocarpus anthelmintica*) seed oil is done by polymerization between crude oil and dicyclopentadiene (DCPD) 20-30% by weight, in an Electro-Vapour Plant in closed system at a temperature ranging from 270° to 280°C. The reaction time was 4 to 6 hours and the producing pressure was 45 to 55 psig. The modified oil products are highly viscous, easily drying and suitable for using as interior gloss paint. This report deals with an experiment on a semi-pilot scale. - Authors.

PHARMACEUTICALS & NATURAL PRODUCTS

RESEARCH DIVISION

81-83/681

BURZYNSKA, Maria Halina and TEPSITHAR, Pattama. The quantitative determination of oryzanol in rice bran oil from the Thai Edible Oil Ltd., Co. (การศึกษาปริมาณ Oryzanol ในตัวอย่างน้ำมันรำข้าว ของบริษัทน้ำมันบริโภคไทย) Rep. no. 1 on Class. Invest. no. 24-08, 1981, 6p. (In Thai.) CONFIDENTIAL.

Key Words: Rice bran oil, Oryzanol, Vegetable oils, Chemical analysis.

The quantities of oryzanol in crude rice bran oil as well as refined oil from the Thai Edible Oil Ltd., Co. were determined, using the thin layer chromatography and spectro photometric technique according to Tanaka, A. (1971) "Separation and quantitative analysis of ferulates in rice bran oil by thin layer chromatography".

The refined oil contained 0.08% oryzanol as against 1.43% for crude oil. - Authors.

81-83/682

BURZYNSKA, Maria Halina, RUKPANICHSIRI, Prasart and TEPSITHAR, Pattama. Semi-quantitative estimation of Vitamin E in rice bran oil from Thai Edible Oil Ltd., Co.. (การศึกษาปริมาณไวตามิน E

ในตัวอย่างน้ำมันรำข้าวของบริษัทน้ำมันบริโภคไทย) Rep. no. 1 on Class. Invest. no. 24-23, 1982, 9p. (In Thai.) CONFIDENTIAL.

Key Words: Rice bran oil, Vegetable oils, Tocopherol.

Quantities of vitamin E in crude rice bran oil as well as refined oil from the Thai Edible Oil Ltd., Co. were determined, using the colorimetric technique according to Sgorgy and Pearson (1967).

The refined oil was found to contain 0.05 ± 10% vitamin E as against 0.15 ± 10% for crude oil. - Authors.

81-83/683
BURZYNSKA, Maria Halina, TEPSITHAR, Pattama and SANKAMNOED, Dhunyporn. The quantitative determination of oryzanol in soda food from the Thai Edible Oil Ltd., Co.. (การศึกษาปริมาณ ORYZANOL ในวัสดุเหลือทิ้ง) Rep. no. 2 on Class. Invest. no. 24-08, 1982, 13p. (In Thai.) CONFIDENTIAL.

Key Words: Oryzanol, Industrial wastes, Vegetable oils.

The investigation on oryzanol content in a sample of soda food from the Thai Edible Oil Ltd., Co. was carried out, using the extraction method according to Tsuchiya (1957), with some modifications, before making oryzanol assay by thin-layer chromatographic and spectrophotometric technique as described by Tanaka (1971).

It was found that the soda food contained 2.41 ± 0.22% oryzanol. - Authors.

81-83/684

DISYABOOT, Pornsawarn, WASUWAT, Sasithorn, TEPSITHAR, Pattama and SRICHANT, Siripen. Study on the antibacterial properties of *Alpinia* sp. (การศึกษาคุณสมบัติในการยับยั้งการเจริญของเชื้อโรคของสมุนไพรข่าต่าง ๆ) Rep. no. 1 on Res. Proj. no. 21-10, 1981, 10p. (In Thai.)

Key Words: *Alpinia*, Medicinal plants, Antimicrobials.

Preliminary investigation on the basis of Disc diffusion and Serial dilution has revealed that extracts of various species of Alpinia possess antibacterial action, *in vitro*, against *B. subtilis*, *Sarcina lutea*, *Staphylococcus aureus*, *Lactobacillus buchneri*, *E. coli*, *Salmonella typhi*. Acute toxicity study has shown low toxic and high LD_{50} value, and CNS activity screening has indicated that only the hexane extract possesses hyperactivity action for *Alpinia* sp. and CNS depressant for *A. conchigera*. The Spectrophotometer (UV) Maximum absorbtion of the *Alpinia* sp. extracts are 280 for alcohol extract, as against 240 and 290 nm for hexane and benzene respectively. The maximum absorbtion of the *A. conchigera* are 280-290 for alcohol, 250-260 for hexane and 310-320 nm for benzene extract. Further study on the alcohol extracts is being carried on at TISTR in order to explore the possibilities of using such extracts as raw materials for antibacterial products industry. - Authors.

81-83/685

WASUWAT, Sasithorn and NANDHASRI, Pranee. Gelatin capsule production from local raw material, pork skin. (การผลิตเยลาตินแคปซูลจากหนังหมู) Rep. no. 1 on Res. Proj. no. 21-10, 1982, 12p. (In Thai.)

Key Words: Gelatin, Pork skin, Waste utilization, Gelatin capsule.

The imports of gelatin products and gelatin capsules were estimated not less than 40 million baht (CIF) each year, and there is an increasing trend every year.

Thailand Institute of Scientific and Technological Research (TISTR) had since 1963 started research and development projects on gelatin capsule production from local raw materials. It was found that the quality of gelatin made from pork skin meet the USP standard, and the capsules made from TISTR gelatin contain an approximate rate of water absorptability and disintegration to that of the imported products.

It has been estimated that 1,800 tons of pork skin would be sufficient for capsule production for local use per annum. The total production of pork skin in Thailand is about 8,000 tons per annum. Thus to produce gelatin and gelatin capsules domestically in Thailand is probable and worthwhile. - Authors.

81-83/686

WASUWAT, Sasithorn, NANDHASRI, Pranee, DISYABOOT, Pornsawan, TEPSITHAR, Pattama, SRICHANT, Siripen and SAJJAPONGSE, Tommarat. An experiment on the production of papain powder. (การทดลองผลิตปาเปนผง) Rep. no. 1 on Class. Invest. no. 23-22, 1981, 14p. (In Thai.) *CONFIDENTIAL.*

Key Words: Papain, Papaya.

Experimental results on the production of papain as shown in the TISTR 1978 summary report has interested the Chembergy Company Ltd. which results in awarding TISTR a contract to conduct an experiment on the production of papain from papaya latex. The purpose is to produce the papain sample for proteolytic activity and to study the demand of world market, including the assessment of preliminary cost of production prepared by TISTR.

Laboratory result has indicated that papain powder possessing proteolytic activity of 30,000 unit/mg could be produced from papaya latex obtained from papaya fruits in Ratchaburi and Samut Sakhon. The papain activity obtained was above that being traded in the world market. The derived yield came to approximately 10-12 per cent of latex. - Authors.

81-83/687

WASUWAT, Sasithorn, SOONTHORNSARATOON, Pattama, ROJANAPHODI, Wannee, PHICHA, Phorntipa and NANDHASRI, Pranee. A study on

spermicidal efficiency of Thai indigenous medicinal plants. (การวิจัยสำรวจประสิทธิภาพ SPERMICIDE ของสมุนไพรไทย เพื่อคัดเลือกเป็นวัตถุดิบในการผลิตยาคุมกำเนิด) Rep. no. 1 on Res. Proj. no. 25-12, 1983, 26p. (In Thai.)

Key Words: Medicinal plants, Contraceptives, Spermicide.

The screening of 11 contraceptive medicinal plants of spermicidal type, for vaginal application, indicated that extracts from two kinds of edible medicinal plants, *A. galanga* and *Z. cassumunar* possessed spermicidal effect *in vitro* (using ox sperm standard 1500 million sperms/ml, made into stock dilution 120-160 million sperms/ml.) The spermicide ED_{100} of the active fractions, compared closely with that of positive control sample, i.e. nonylphenoxy polyethoxy ethanol, together with other pharmacological study results, indicated high possibility to utilize the active fractions, derived from these two kinds of medicinal plants, with a reasonable degree of safety in birth control by vaginal application. Further study on comparing extracts from the two kinds of medicinal plants for the purposes of birth control and economic development is now being in progress. - Authors.

Essential Oils & Cosmetics Lab.

81-83/688

HUET, Raymond, WASUWAT, Sasithorn, NANDHASRI, Pranee and

DISYABOOT, Pornsawan. Study on Kradang-nga (Thai ylang-ylang) oil. Rep. no. 4 on Res. Proj. no. 53/1, 1982, 16p.

Key Words: Ylang-ylang, Essential oil crops, Kradang-nga.

Thai ylang-ylang oil, extra, first, second and third grades has been produced and analysed by physico chemical, GLC and TLC methods and compared with authentic samples obtained from France.

The GLC study indicated that geranyl acetate, caryophyllene, germacrene, α and β farnesenes, benzyl benzoate, geraniol, linalool and benzyl acetate were the components of the oil.

The percentage yields obtained were 0.54, 0.34, 0.19 and 0.27 for extra, first, second and third grade oil, respectively. The organoleptic test was favourable. Further work on industrial development is still carried on at TISTR. - Authors.

81-83/639

NANDHASRI, Pranee, PICHITAKUL, Nitasna and PUNRUCKVONG, Acharaporn. Guava leaf oil. (น้ำมันใบฝรั่ง) Rep. no. 6 on Res. Proj. no. 20-61, 1981, 13p. (In Thai.)

Key Words: Guava, Essential oils, *Psidium guajava*.

The hydro-distillation of guava (*Psidium guajava*) leaves of three varieties: Hawaii, Vietnam (Khao Niyom) and Taeng-kwa yield essential oils to the amount of 1.30, 0.51 and 0.88% respectively of dried material weight. The physical constant value of oils derived from these three varieties are slightly different although the major chemical constituents such as d-limonene, caryophyllene and longifolene, determined by gas chromatographical analysis, are conspicuously different. - Authors.

81-83/690

NANDHASRI, Pranee, PUNRUCKVONG, Acharaporn, PO-SU, Apichart, HAYAKIJKOSOL, Chumnong, LAUHASIRI, Pravet and SYAMANONDA, Churai. The analysis for the standard of "Minyak Gosok Oil" and "Sa Sao Herbal Oil" double prawn brand. (การตรวจมาตรฐานน้ำมัน MINYAK GOSOK และยาน้ำมันแซเซ้า ตรากุ้งคู่) Rep. no. 1 on Class. Invest. no. 24-11, 1981, 44p. (In Thai.) CONFIDENTIAL.

Key Words: Minyak Gosok Oil, Sa Sao Herbal Oil, Essential oils.

The purpose of this project is to determine the proper and available method for analysis of the standard of the two brands of oil, i.e. the Double Prawn brand, called "Minyak Gosok Oil" and "Sa Sao Herbal Oil". Each of these two brands of oils, is a mixture of four to five essential oils. The physical and gas chromatograph analysis can directly be applied to Minyak Gosok Oil. The fractional distillation is made to fractionate the herb and the oil frac-

tions of Sa Sao Herbal Oil, then the gas chromatograph analysis is used to analyse those oil fractions. The reconstituted standard essential oil samples of the two types of oil, Minyak Gosok and Sa Sao, are prepared and the results are compared and checked by gas chromatograph analysis. - Authors.

81-83/691

PICHITAKUL, Nitasna and PUNRUCKVONG, Acharaporn. The potential of essential oil production in Thailand. Appraisal Rep. no. 33, 1981, 19p.

Key Words: Essential oil crops.

Thailand used to produce citronella (*Cymbopogon winterianus* Jowitt.), lemongrass (*Cymbopogon citratus* D.C. Stapf.) and basil (*Ocimum basilicum* Linn.) oil. At present essential oil industries in Thailand include those engaged in Japanese mint (*Mentha arvensis* var. *piperascens*) and turpentine (*Pinus merkusii* Jungh). Other types of essential oil industries are either being under investigation for further research or pilot-scale operation.

In Thailand many kinds of raw-materials can be used for producing essential oil. The sources of raw materials both for established commercial oil or new oil of commercial interest may be classified as in the following groups : (1) forest products, (2) agricultural products, (3) processing of available raw materials, and (4) by-products of other industries.

A list of potential essential oil in Thailand is given as follows: forest products -- eucalyptus cajeput (*Melaleuca leucadendron* Limm.) and sapsua (*Eupatorium odoratum* Linn.); agricultural products -- patchouli (*Pogostemon cablin* Benth.), vetiver (*Vetiveria zizanioides* Stapf.), geranium (*Pelargonium* spp.), ylang-ylang (*Cananga odorata* Baill.), holy-basil (*Ocimum sanctum* Linn.), kaphrao-chang (*Ocimum gratissimum* Linn.), phlai (*Zingiber cassumunar* Roxb.), krachai (*Boesenbergia pandurata* Schlechter.), Jasmin (*Jasminum sambac*) and kek huai (*Chrysanthemum morifolium* Ramat.); processing of available raw materials -- ginger (*Zingiber officinale* Roscoe.); by products of other industries -- lime (*Citrus aurantifolia* Swingle) and porcupine orange (*Citrus hystrix* D.C.). - Authors.

81-83/692

PICHITAKUL, Nitasna, PUNRUCKVONG, Acharaporn, PRAKOBNANAKIT, Sukonth, NANDHASRI, Pranee and KEMACHANTREE, Narong. Preliminary study of patchouli oil in Thailand. (การศึกษาเบื้องต้นของน้ำมันแพตชูลีในประเทศไทย) Rep. no. 5 on Res. Proj. no. 20-61, 1981, 13p. (In Thai.)

Key Words: *Pogostemon cablin*, Essential oil crops.

Patchouli (*Pogostemon cablin* Benth) is a small herbaceous perennial plant. Its leaves contain a good odour. Patchouli oil is one of the most valuable ingredients in perfumes. The oil was obtained by means of steam distillation

of dried leaves. This kind of essential oil yields a strong and lasting odour.

The experiment on cultivation and distillation were carried out at the Thailand Institute of Scientific and Technological Research (TISTR), The fresh weight obtained (including leaves and twigs) came to 4,051 kg/rai. The oil yield from dried leaves amounted to 2.44-2.69%. The distillation was done for 20 hours in a pilot-scale distillation unit.

The study has shown that the physico-chemical properties of patchouli oil met the British Standard (BS. 1965). Thai patchouli oil has been accepted by the perfume experts. A study on the comparison of chromatogram has indicated that there was an insignificant difference between Thai and commercial patchouli oil. - Authors.

ECOLOGICAL RESEARCH DIVISION

81-83/693

PAKARNSEREE, Lakkana. Chlorinated hydrocarbon residues in fresh water fish from Bangkok. (การหาปริมาณยาฆ่าแมลงคลอรีเนตไฮโดรคาร์บอน (chlorinated hydrocarbon) ในปลาน้ำจืดที่นิยมบริโภคในกรุงเทพฯ ภาคกลาง และภาคเหนือของประเทศไทย) Rep. no. 4 on Res. Proj. no. 20-25, 1982, 28p. (In Thai.)

Key Words: Pesticide residues, Fresh water fishes, Bangkok, Chlorohydrocarbon, Water pollution.

For analysis of both the quality and quantity of residual chlorinated hydrocarbon in edible fresh water fish from food markets in Bangkok, central and northern regions of Thailand, an estimation of DDT, DDE, TDE, BHC, lindane, heptachlor, heptachlor epoxide, aldrin, dieldrin and endrin was made on the basis samples of fresh-water fish commonly found in every part of the country, such as *Ophicephalus striatus*, *Clarias macrocephalus*, *Clarias batrachus*, *Mystus nemurus*, *Wallagonia attu*, *Notopterus notopterus*, *Puntius bramoides*, *Cyclocheilichthys enoplos* and *Pangasius pangasius* etc.

From a chemical analysis of 105 samples, 98.10% contained chlorinated hydrocarbon residues. The highest percentage was total DDT (i.e. DDT and its metabolite TDE and DDE), being 95.24%, whereas the lowest percentage was lindane being 33.33%. The highest average concentration of total DDT and aldrin was found in *Wallagonia attu* from northern region, to be .5023 and .0132 ppm respectively. The highest average concentration of heptachlor, dieldrin and BHC was found in *Clarias batrachus* from Bangkok market to be .0161, .0401, and .0704 ppm respectively. The highest average concentrate of endrin was found in *Mystus nemurus* from northern regions to be .0706 ppm; but the highest average concentration of lindane was found in *Puntius bramoides* from northern region to be .0126 ppm. The average

concentration of chlorinated hydrocarbon in fresh water fish from northern region was higher than from other regions. - Author.

81-83/694

PAKARNSEREE, Lakkana. Chlorinated hydrocarbon residues in fresh water fish from north-eastern region of Thailand. (การหาปริมาณพิษตกค้างคลอริเนต ไฮโดรคาร์บอน (chlorinated hydrocarbon) ในปลาน้ำจืดที่นิยมบริโภคจากภาคตะวันออกเฉียงเหนือของประเทศไทย) Rep. no. 3 on Res. Proj. no. 20-25, 1982, 35p. (In Thai.)

Key Words: Pesticide residues, Fresh water fishes, North-eastern Thailand, Water pollution, Chlorohydrocarbon.

In order to determine quantitatively and qualitatively the chlorinated hydrocarbon residues in 36 species, 110 samples of edible fresh water fish from north-eastern region of Thailand were involved in the experiment. Chlorinated hydrocarbon pesticides analyzed in this study were namely DDT, DDE, TDE, lindane, heptachlor, heptachlor epoxide, aldrin, dieldrin and endrin.

The results obtained were: 98.18% of the samples contained chlorinated hydrocarbon residues. The mean values of residual pesticides content in fish were as follows: heptachlor .0052 ppm, aldrin .0012 ppm, heptachlor epoxide .002 ppm, dieldrin .001 ppm, endrin .001 ppm, DDE .0102 ppm, TDE .0037 ppm, DDT .0340 ppm and total DDT .0479 ppm, *Puntius gonionotus* contained the highest average concentration of chlorinated hydrocarbon residues (DDE .0674 ppm, DDT .2428 ppm,

total DDT .3672 ppm, and heptachlor epoxide .0097 ppm). Next in order of magnitude are: *Labeo stigmapleura*, *Helicophagus waandersii*, *Clarias macrocephalus*, *Mystus nemerus*, *Macrognathus aculeatus* and *Botia hymenophysa*. On comparing the water sources areas where these fish were caught, it was found that, fish from Khong River, Amphoe Muang, Nakhon Phanom Province constituted the highest average concentration of chlorinated hydrocarbon. In addition, a study of chlorinated hydrocarbon residues in indigenous food products such as fermented fish and fish kidney has revealed that fermented fish kidney which contains high cholesterol content absorbed the highest percentage of such pesticide residues. In contract, fermented fish like Pla Ra and Pla Som was found to contain on the average the lowest chlorinated hydrocarbon concentration. - Author.

AUTHOR INDEX

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