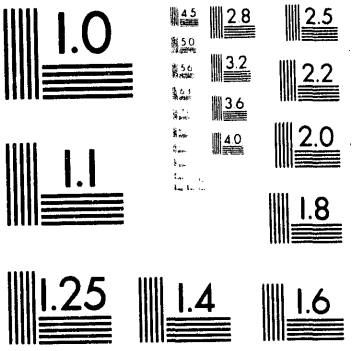
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1 of 1

FINAL REPORT

for

COMMUNITY GEOTHERMAL TECHNOLOGY PROGRAM

by

PAPAYA PRODUCTS of HAWAII

on

FRUIT DRYING WITH GEOTHERMAL ENERGY

MARCH 14, 1988

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PREFACE

This is a report of work performed for the Community Geothermal Technology Program, a small grant program administered jointly by the Hawai'i Natural Energy Institute and the State of Hawai'i Department of Business and Economic Development.

This project was one of five funded under the pilot phase of the program. The grantees all began in 1986, and completed their work between October 1987 and April 1988. Funds for the pilot phase were provided by the U.S. Department of Energy and the County of Hawai'i.

The five Community Geothermal Technology Program projects were the first attempts to make direct use of geothermal heat and byproducts in Hawai'i. The success of these five grants has encouraged others to consider the use of geothermal energy in their businesses. A second round of grants was awarded in early 1988, and will demonstrate further applications of geothermal heat, brine and silica.

The opinions expressed in this report are those of the author, and are not necessarily shared by the program administrators, funding agencies, or others involved in the program. Responsibility for the accuracy of the data provided in this report lies with the author.

The enthusiasm, talents, and efforts of the grantees are much appreciated, and I look forward to continuing to work with them and with future recipients of grants from the Community Geothermal Technology Program.

Andrea Gill Beck, Administrator
Community Geothermal Technology Program

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I. GOALS AND OBJECTIVES.

The goal of this project was to use geothermal energy to dry agricultural products. The agricultural products tested were green papaya powder, banana slices and pineapple slices.

A second objective of this project was to determine what would be involved in establishing a commercial venture using this energy.

Although the practice of drying in truck dryers and the utilization of geothermal energy are not new, the two technologies were merged at the Puna Research Center in order to derive information that can be of use in the commercial arena.

II. CONCLUSIONS.

We clearly demonstrated the feasibility of using geothermal energy to dry certain agricultural commodities. These preliminary experiments produced enough raw data to be able to design a commercial system if desired. Although some of the samples dried were not of commercial grade, the parameters needed to operate a commercial dryer were established. One of the largest drawbacks was the lack of proper recording and controlling instrumentation. The drying schedule for papaya powder and pineapple slices was about 24 hours. The temperature for drying must be kept within certain limits. By having some automatic controls the process and the product would benefit.

Small cottage industries, using low cost geothermal energy, can be created faster and with smaller capital investment than large industrial plants, which we hope will be the scenario for commercial uses of geothermal energy in the immediate future.

III. DESCRIPTION OF WORK.

The first step after signing the agreement was to design and build the dryer. The dryer was constructed from plywood. Initially, a small 8'L x 8'W x 8'H reefer was to be used as the drying chamber. However, our experience dictated that we build a longer and narrower dryer. The final dryer design was 18'L x 4'W x 6'H. Next, the trucks for the drying trays were constructed. These trucks are wooden frames on casters that hold the aluminum drying trays in the dryer. The trucks hold the trays stacked vertically, two trays side by side, with the stack 20 slots deep, for a total of forty trays per truck, with three trucks per dryer, for a total of 120 trays per dryer. The dryer and trucks were shipped to the geothermal site from Keaau and installed.

The papayas, pineapples and bananas were prepared at the Papaya Products of Hawaii plant in Keaau. The initial preparation of these three products differs.

Green papaya powder production starts with mature, green, fresh papayas. The papayas are washed to remove all field dirt and chemicals. The fruit is then sliced in half and some of the seeds removed. The fruit halves are then coarsely ground in a commercial food preparation machine. Then, the prepared fruit is run through an extractor to separate the pulp from the juice. The pulp is then placed on the trays for drying.

The bananas go through the same washing procedure. The bananas are peeled, sliced longitudinally and placed on the trays for drying.

The pineapples go through the same washing procedure. The pineapples are peeled and sliced to produce round slices. The pineapple slices are placed on the trays for drying.

For sanitation, these products were prepared in Keaau and transported to the dryer in large covered plastic containers. The products were placed on the trays at the concentration of 4#, 11# and 7.5# per tray for papaya powder, banana and pineapple, respectively. These weights per tray result in a dried weight yield of 0.48#, 1.7#, and 0.6# per tray respectively. All products dried well between 110 and 130 degrees Fahrenheit.

After drying overnight, all products were scraped off the trays into large plastic containers and returned to Keaau. After appropriate packaging, the bananas and pineapples are ready for shipment. The papaya powder must be ground from the dried pulp obtained from the drier. Then the powder is ready for shipment in plastic containers.

Enclosed with this report, under Section V. RESEARCH RESULTS, is the log generated by the processing personnel for the sample runs. It can be seen in these logs that there were some problems with the raw product. In some cases the banana products appeared too green for proper processing, and, in the case of papayas, some fruit was too ripe and the sugars burned, causing browning. This points out a very fundamental aspect of the food processing industry, that of good monitoring of raw ingredients.

IV. PROBLEMS AND CHANGES.

The largest problem was that of not enough automatic controls to obtain consistent results to establish the needed processing protocol.

In our original discussions with representatives of the Hawaii Energy Extension Service and Noi`i O Puna, there was some indication that there might have been some help from The University of Hawaii or The Natural Energy Laboratory of Hawaii with needed equipment. Because Papaya Products of Hawaii maintains an electric drier in Keaau, its components are not compatible for use on a fluid heat source. Because the intent of these projects is to explore the commercial advantages of geothermal energy, the source energy should be available in any form the recipients need with some form of control and metering. This would also help with future planning and usage rates.

In order to help these projects along, it would be to Noi`i O Puna's and the recipient's advantage to have some help from The University of Hawaii in the design of the connection between the recipient's equipment and the available utilities at the project site. Most of the recipients have ideas about how their processes work, but many may not have the knowledge about how to control the temperature, humidity and flow of the fluid energy. By having a student engineer assigned to this project, the engineer could help with the needs of the recipients and could help them find the necessary equipment to control their projects.

It appears that the second phase recipients have a ceiling of $15,000 instead of the $10,000 for Phase One. Hopefully, this will allow the Phase Two recipients to construct their projects with more sophisticated controls.

V. RESEARCH RESULTS.

The data derived from the operations outlined in Section III are included at the end of this report in APPENDIX A. The data show the timetable over which the drying procedure was established. The drying times and temperatures were confirmed for the products involved. The processing on trays with the amount of heat at the project site was adequate.

In summary, the results for papaya drying show that a temperature of 120 degrees F can be used successfully if the fruit is mature green and not overly ripe. The results of drying bananas showed that the dryer temperature should be the same as that of papaya, 120 degrees F. Also, the ripeness of the bananas is as important as that of the papayas. The results of pineapple drying showed the thickness of the slices should be very uniform to allow even drying throughout the whole dryer. Once again, 120 degrees F seems to be a good drying temperature.

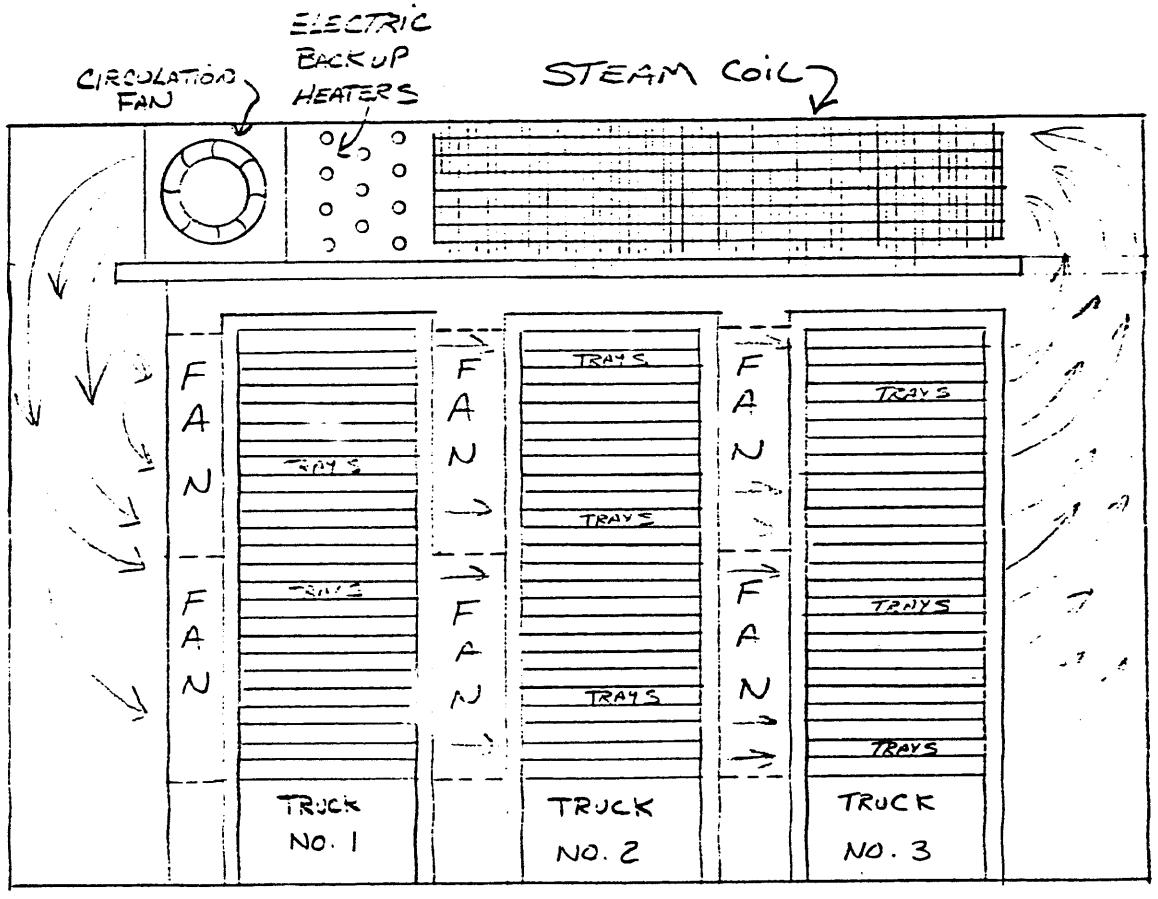
If commercial property could be developed near the geothermal area, a small industrial park could support small cottage industries whose common interest are heat intensive processes. One concern is that the geothermal laboratory is in a fault zone which may limit zoning changes and, more importantly, financing arrangements.

VI. FISCAL REPORT.

The fiscal report is included and follows the form presented in the grant proposal. The report is presented as APPENDIX B. There were no significant changes in the fund amounts.

VII. EQUIPMENT.

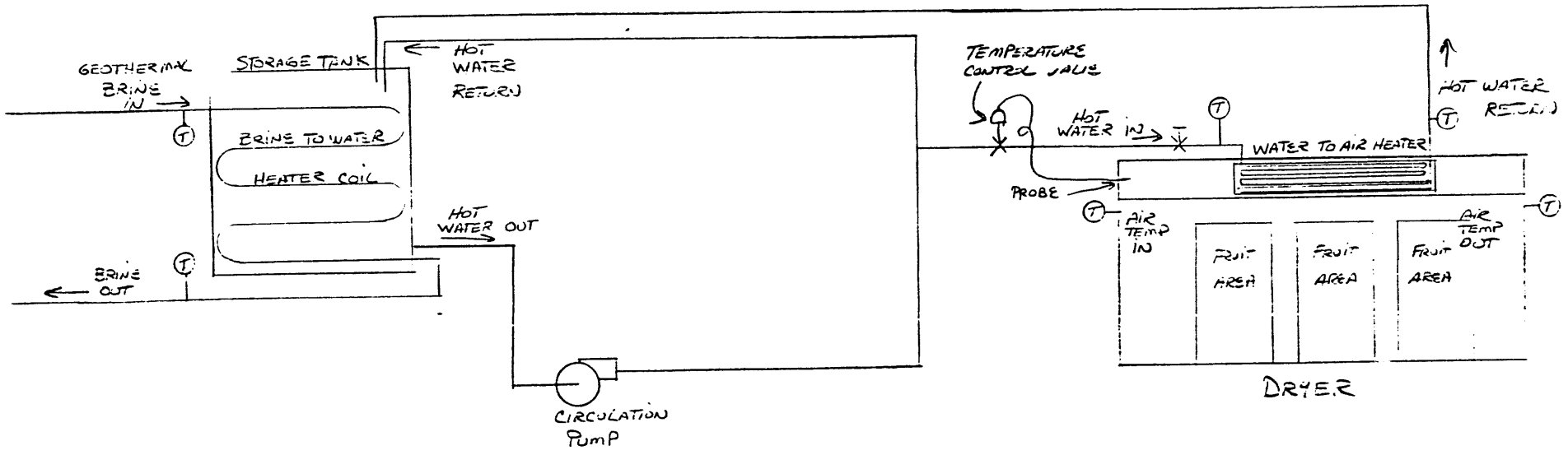
The Hawaii Energy Extension Service has determined that the materials and equipment involved in this project are the property of Papaya Products of Hawaii, since no grant funds were used to purchase equipment.



GEOTHERMAL FRUIT DRYER
AIR FLOW, TRUCK LOCATION,
HEATER LOCATION

FIGURE NO. 1

PAPAYA PRODUCTS OF HAWAII
DRYER FOR NELH
5/9/81 BDF



PIPING ARRANGEMENT OF GEOTHERMAL HEAT EXCHANGER AND FRUIT DRYER

FIGURE NO. 2

PAPAYA PRODUCTS OF HAWAII
DRYER FOR NELH
BDF

APPENDIX A

TEST RECORDS

APPENDIX A

MAXIMUM CAPACITY FOR DRYER DEMONSTRATION UNIT = 120 TRAYS

FOR BANANA:

11#/TRAY OF RAW PRODUCT (UNPEELED) OR
1320#/DRYER UNIT (52% RUBBISH OR 686#)
211# (16%) DRIED BANANA YIELDED PER RUN AT 100% CAPACITY (36HOURS)

18 WORK HOURS TO WEIGH /PEEL/LOAD @ $4.00/ HOUR =	$72.00
4 WORK HOURS TO UNLOAD/WEIGH @ $4.00/HOUR =	$16.00
1 WORK HOUR TO CLEAN UP @ $4.00/HOUR =	$4.00
3 WORK HOURS TO MONITOR @ $4.00/HOUR =	$12.00
TOTAL LABOR COSTS =	$104.00
RAW RESOURCE COSTS 1320# @ $0.10/# =	$132.00
TOTAL COSTS (WITHOUT UTILITIES) = OR $1.12/POUND DRIED	$236.00
SUGGESTED PRICE TO WHOLESALERS	$3.50/LB.
SUGGESTED PRICE TO RETAILERS	$4.50/LB.
SUGGESTED PRICE TO CONSUMERS	$6.50/LB.

FOR PAPAYA POWDER:

4#/TRAY OF GRATED, DRAINED PULP OR
480#/DRYER UNIT
58## (12%) DRIED PULP YIELDED PER RUN AT 100% CAPACITY (24HOURS)

20 WORK HOURS TO WEIGH /PEEL/LOAD @ $4.00/ HOUR =	$80.00
10 WORK HOURS TO UNLOAD/WEIGH @ $4.00/HOUR =	$40.00
1 WORK HOUR TO CLEAN UP @ $4.00/HOUR =	$4.00
5 WORK HOURS TO MONITOR @ $4.00/HOUR =	$20.00
TOTAL LABOR COSTS =	$144.00
RAW RESOURCE COSTS 1200# @ $0.10/# =	$120.00
TOTAL COSTS (WITHOUT UTILITIES) = OR $4.55/POUND DRIED	$264.00
SUGGESTED PRICE TO WHOLESALERS	$7.50/LB.
SUGGESTED PRICE TO RETAILERS	$8.75/LB.
SUGGESTED PRICE TO CONSUMERS	$11.50/LB.

APPENDIX A

FOR PINEAPPLE:

7.5#/TRAY OF RAW PRODUCT (UNPEELED) OR
900#/DRYER UNIT (53.3% RUBBISH OR 481.5#)
72## (6%) DRIED PINEAPPLE YIELDED PER RUN AT 100%
CAPACITY (48HOURS)

7 WORK HOURS TO WEIGH /PEEL @ $4.00/ HOUR =	$28.00
4.25 WORK HOURS TO LOAD DRYERS @ $4.00/HOUR =	$17.00
1 WORK HOUR TO CLEAN UP @ $4.00/HOUR =	$4.00
4 WORK HOURS TO MONITOR @ $4.00/HOUR =	$16.00
TOTAL LABOR COSTS =	$89.00
RAW RESOURCE COSTS 900# @ $0.15/# =	$135.00
TOTAL COSTS (WITHOUT UTILITIES) = OR $3.15/POUND DRIED	$224.00
SUGGESTED PRICE TO WHOLESALERS	$5.50/LB.
SUGGESTED PRICE TO RETAILERS	$6.90/LB.
SUGGESTED PRICE TO CONSUMERS	$10.00/LB.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
		from project manager	110°F	130°F	before INSULATION
05/15/87	0825	check air temperature	160°F	180°F	after INSULATION
					without fans
	0830	set trays			wrong size
		set fans in bay #2			adjust fan shelf
	0835	set fan setting on high			
	0855	measure Δt	148°F	180°F	with fans
					Δt dropped 12°F
		turn fans off			

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
05/30/87	0800	weigh banana			gross wt.=116#
	0820	turn on fans			high setting
	0825	process banana			9 1/2 trays
	0910	load dryer	148°F	175°F	load temp.
	0932	monitor	135°F	175°F	intial run temp.
	0945	weigh rubbish			rubbish wt.=55#
		weigh boxes			box wt.=10#
		figure process weight			net wt.=51#
	1820	monitor	144°F	175°F	skin development
	1823	close input 1/2 turn			input 10% closed
	1827	monitor	138°F	175°F	
	1828	close input 1/2 turn			input 20% closed
	1836	monitor	136°F	175°F	
	1837	close input 1/2 turn			input 30% closed
	1841	monitor	136°F	175°F	
05/31/87	0735	monitor	149°F	180°F	banana 80% dried
	0736	close input 1 turn			input 50% closed
	0741	monitor	149°F	180°F	
	0744	close input 1/2 turn			input 60% closed
	0749	monitor	149°F	180°F	
	0750	close input 1 turn			input 80% closed
	0759	monitor	144°F	180°F	
	0800	close input 1/2 turn			input 90% closed
	0805	monitor	134°F	180°F	
	1745	monitor	90°F	110°F	90% is too much
	1746	open input 1/4 turn		190°F	input 15% open
					fluid instant Δt
	1753	monitor	102°F	180°F	
	1759	monitor	106°F	180°F	
	1805	monitor	110°F	180°F	
	1811	monitor	114°F	180°F	
	1815	monitor	115°F	180°F	air Δt stabilized
06/01/87	0720	monitor	124°F	185°F	bananas finished
	0721	open input 4 1/4 turns			input 100% open
		unload			
	0731	weigh end product			dried wt.=16#
	0735	finish			sampled 9 banana

Conclusion after banana I: System would benefit from SOLENOID valve in the hot water input line activated by Δt of air, would require thermostat(s) to monitor air temperature inside of drier unit.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
06/10/87	1000	weigh papaya pulp			gross wt. 46#
		drive to project			
	1005	monitor	147°F	178°F	without fans
		turn fans on			*note: removed
		clean trays			two trays silica, one wet, one dry
	1015	monitor	144°F	175°F	
		load trays with papaya			11 trays
	1040	monitor	147°F	175°F	
		put trays in bay #2			
	1055	monitor	138°F	175°F	
	1100	weigh pails			pails weigh 3#
		clean pails			net weight 43#
	1115	finish			
	1650	monitor	145°F	180°F	
		close input 4 turns			input 80% closed
	1700	monitor	145°F	180°F	
		close input 1/4 turn			input 85% closed
	1710	monitor	140°F	180°F	
	1720	monitor	135°F	180°F	
		open input 1/4 turn			input 20% opened
	1955	monitor	135°F	180°F	thin layered trays dry, thicker ones still wet, rotate wet ones up
	2000	open input 1/4 turn			input 25 % open
	2005	monitor	134°F	175°F	Δt stabilized
06/11/87	0855	monitor	147°F	180°F	pulp dry
		remove dry pulp			
		turn fans off			
	0935	monitor	152°F	180°F	
		clean up			
		weigh end product			5.25# net weight
	0955	finish			

Conclusion after papaya I: System would benefit further if humidity of air inside drier unit could be monitored with the addition of a hygrometer, and, if air flow could be vented to release moisture allowing dryer air to circulate. For the next run I recommend filling the drier to 1/3 to 2/3 capacity.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
)7/08/87	0900	pick up papaya pulp			
		weigh papaya pulp			net Wt. 76#
	0930	arrive at project			
		monitor	144°F	175°F	
		turn fans on			
		load trays with papaya			19 trays
	1000	monitor	144°F	175°F	
		put trays in bay #2			
		open exhaust vent 50%			
		open intake vent 100%			
	1005	monitor	124°F	175°F	
	1010	monitor	124°F	175°F	
	1030	monitor	126°F	175°F	
	1035	clean up			
	2000	monitor	138°F	175°F	
	2015	monitor	138°F	175°F	
)7/09/87	0720	monitor	144°F	175°F	product dry
	1110	monitor	144°F	175°F	
		unload end product			product brown
	1140	finish			
	1400	weigh dried product			8.5# net wt.
	1410	finish papaya II			

Conclusion after papaya II: Stage at which papaya was processed was too ripe for this type of product. Sugars in fruit oxidized quickly at the higher temperatures causing a browning of the finished product. Therefore, fruit for this product must be mature green papaya but showing no signs of ripeness before processing and temperatures could be decreased to between 120°F-130°F. Still recommend utilizing at least 1/3 to 1/2 of drier.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
07/09/87	0800	pick up BANANAS			gross wt. 280#
	1040	pick up two workers			
	1110	arrive Pohoiki site			
		monitor	144°F	175°F	
		process banana			2 workers
	1200	load banana in bay #1			
		clean up			
	1310	monitor	116°F	175°F	
	1330	weigh rubbish			120# rubbish 20# green 140# processed
	2000	monitor	130°F	175°F	
07/10/87	0730	monitor	149°F	180°F	
	1230	monitor	154°F	190°F	
	1330	monitor	156°F	190°F	
	2000	monitor	150°F	180°F	
		unload end product			

Conclusion after banana II: It appears as if the bananas in this project were processed too green as the end product resulted in a hard starchy banana. It is recommended that in the future great care be taken to process only those bananas that are mature and fully ripened. Also drier appeared to be too hot for the desired results. One product that might come out of starchy dried bananas such as these is a banana flour or powder.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
07/09/87	1040	pick up papaya pulp			
		weigh papaya pulp			net Wt. 120#
	1110	arrive Pohoiki site			
		monitor	144°F	175°F	
	1200	put papaya on trays			
	1300	load papaya in bay #2			30 trays
		clean up			
	1310	monitor	116°F	175°F	
	2000	monitor	130°F	175°F	
07/10/87	0730	monitor	149°F	180°F	papaya dry
	1230	monitor	154°F	190°F	
	1330	unload papaya			
		clean up			
		weigh end product			14.25# net wt.
	1430	finish papaya III			

Conclusion after papaya III: As with papaya II it is strongly urged to use mature green papaya before it shows any signs of ripeness to avoid this discoloration of the finished product. Also as I mentioned in papaya II we must test the dryer under a heavier load.

DATE	TIME	ACTION	AIR TEMP	WATER TEMP.	COMMENTS
07/14/87	0745	pick up pineapples			7 cs.
		store at PPofH cool room			
07/15/87	0815	weigh pineapples			gross wt. 301#
		set up			
	0845	process pineapples			two workers
					wedges
					small chunks
					large chunks
					wheels
	1045	weigh rubbish			boxes 21#
					peels 145#
					rot 5#
					total 171#
					net wt. 130#
	1100	drive to Pohoiki			
	1120	monitor	155°F	190°F	
		close input completely			5 turns
		open input 60 min.			input open 20%
		load trays with pineapple			37 trays
	1205	put trays in bay #2			
		monitor	95°F	180°F	
	1215	monitor	115°F	175°F	
		drive to Keaau			
	1245	clean up			
	1345	finish			
	1510	monitor	128°F	175°F	
		close input 10 min.			
	1515	monitor	125°F	170°F	
	1520	monitor	127°F	170°F	
	2010	monitor	133°F	170°F	
		close input 15 min.			
	2020	monitor	126°F	170°F	
	2030	close input 5 min.			
	2040	monitor	122°F	170°F	
07/16/87	0700	monitor	123°F	170°F	product 50% dry
	0715	monitor	123°F	170°F	
	1200	monitor	133°F	190°F	
		close input 20 min.			
	1215	monitor	120°F	190°F	
	1650	monitor	116°F	180°F	product 75% dry
	1720	monitor	116°F	180°F	

	2215	monitor	113°F	180°F	
		unload			7 trays
	2255	monitor	110°F	180°F	
		open input 5 min.			
07/17/87	0730	monitor	104°F	175°F	
		open input 20 min.			
	0800	monitor	114°F	180°F	
		open input 5 min.			
	0830	monitor	120°F	180°F	
	1200	monitor	124°F	180°F	
		close input 20 min.			
	1420	monitor	120°F	180°F	
		unload			22 trays
	1505	monitor	106°F	180°F	
		open input 10 min.			
		turn fans on low			
	1510	monitor	112°F	180°F	
	1730	monitor	124°F	180°F	
07/18/87	0945	monitor	116°F	170°F	
		unload			6 trays
	1010	monitor	116°F	170°F	
	2010	monitor	106°F	160°F	
		unload			2 trays
07/20/87	0730	weigh dried product			gross wt. 26#
					tare 6#
					net wt. 20#

Conclusion after pineapple I: The unusually long period for the drying time can be attributed to two factors; first, the size of the pieces for the test were not uniform (the thicker ones taking much longer to dry); and second, the lower temperature and wet nights. Suggestion would be to size all pieces no thicker than 1/4 inch. Also in the future it would be recommended to plot a drying curve for each different cut of fruit and for each variety of fruit.

DATE	TIME	ACTION	AIR TEMP.	WATER TEMP.	COMMENTS
07/20/87	0800	set up			
	0900	process PINEAPPLES			2 workers 480# gross
	1100	clean up			
	1130	break			
	1200	drive to test site			
	1230	monitor	130°F	160°F	input 100% open
		install two fans in bay #3			6 fans total
		load trays with PINEAPPLES			2 workers 64 trays
		adjust input			close completely
		open input 80 min.			
	1330	put trays in bay #1 and #2			40 in #1, 24 in #2
		monitor	106°F	160°F	
		open input 40 min.			
	1335	monitor	114°F	150°F	heavy rain
		drive back to plant			
	1405	clean up			
		drive back to test site			
	1445	monitor	116°F	150°F	
	1455	open input 20 min.			
	1505	monitor	116°F	150°F	
		open input 20 min.			
	1610	monitor	108°F	130°F	heavy rain
		open input full			
	2005	monitor	128°F	170°F	
07/21/87	0707	monitor	142°F	180°F	
		adjust input			close completely
		open input 80 min.			
	0800	process pineapple 2			2 workers 280# gross
	0900	clean up			
	0930	drive to test site			
	1000	monitor	133°F	175°F	
		close input 40 min.			
		load trays with pineapple 2			2 workers 38 trays
	1040	put trays in bay #2 and #3			16 in #2, 22 in #3
		clean up			
		weigh test 1 and 2			70g and 65g
	1055	monitor	106°F	175°F	

		open 20 min			
	1105	monitor	108°F	175°F	
		open 20 min.			
	1535	monitor	96°F	100°F	power off
		adjust input			open completely
	1542				power on
		unload			18 trays A)
	1630	monitor	96°F	110°F	
	2050	monitor	102°F	120°F	heat exchanger ?
07/22/87	0700	monitor	138°F	190°F	
		adjust input			close completely
		open 40 min.			
	0710	monitor	126°F	190°F	
	2100	monitor	106°F	190°F	
		open 20 min.			
		unload			40 trays B)
	2155	monitor	116°F	190°F	
07/23/87	0650	monitor	101°F	120°F	system down
	0930	monitor	93°F	100°F	
	1100	monitor	93°F	95°F	
		turn on coils			
		set thermostats			b-110°F,f-120°F
	1115	monitor	118°F		
	2140	monitor	116°F		
		unload			26 trays C)
	2220	monitor	116°F		
07/24/87	0600	monitor	116°F		
	1200	monitor	116°F		
	1700	monitor	116°F		
		unload			17 trays D)
	1800	monitor	116°F		
07/25/87	1200	monitor	116°F		
		unload			1 tray E)
	1215	finish			
	1230	weigh finish product			

A) 9.5#
B) 21.0#
C) 16.5#
D) 11.0#
E) 0.5#
58.5# total

Conclusion after pineapple II: Pineapples must be cut uniformly to assure timely drying schedule. An automated monitoring system could easily pay for itself in the long run since the present system requires constant manual monitoring.

APPENDIX B

FINANCIAL REPORT

APPENDIX B

COST CATEGORY	FROM C.G.T.P.	FROM COST SHARING	TOTAL
EQUIPMENT			
a. Fan	$0	$800	$800
b. Motor & Drive	$0	$550	$550
TOTALS	$0	$1350	$1350
MATERIALS			
a. Heat exchanger materials	$600	$0	$600
b. Lumber	$300	$0	$300
c. Steel	$400	$0	$400
d. Misc. Hardware	$150	$0	$150
e. Electric controls	$600	$0	$600
f. Truck Fabrication	$500	$0	$500
g. Plumbing Supplies	$500	$0	$500
h. Food Bins	$266	$0	$266
j. Temp. Probes	$150	$0	$150
k. Temp. Indicator	$0	$1200	$1200
l. Aluminum Trays	$600	$0	$600
TOTALS	$4066	$1200	$5266

DO NOT MICROFILM
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PAPAYA
PRODUCTS OF HAWAII

GREEN PAPAYA GRANULES AND POWDER

PRODUCT DESCRIPTION AND SPECIFICATION

Papaya Products of Hilo was formed to manufacture and market several nutritional products and processes developed by Dr. Kurt Koesel based upon the use of highly nutritional green papaya which retains a higher percentage of its enzyme and vitamin content compared to the usual high sugar content of ripe papaya products now on the market. **Papaya Products of Hilo** does have flavorful ripe papaya products for those who prefer greater sweetness.

The green or ripe papaya granules are a good source of roughage and flavor while the green papaya provides the high enzyme content if preferred.

These granules can be used as a flavorful additive to cereals and salad mixes, and also packaged as a nutritional roughage fiber ingredient.

Per the U.S. Department of Agriculture: "Papaya is a source of an important digestive ferment called papain, similar, (but more effective) in its action to pepsin. Papaya is generally recognized as of value in promoting health, and its increasing popularity is partly due to this fact."

"It is also an excellent source of Vitamin A, a good source of Vitamin C, a fair source of Vitamin G, and has an appreciable amount of Vitamin B."

U.S. Department of Agriculture
Washington D.C.
Circular #633
Papaya Production in the U.S.

P. O. Box 240 Keaau, Hawaii 96749 Phone (808) 966-8727 Telex 5106004620

PAPAYA
PRODUCTS OF HAWAII

SPECIFICATIONS

Typical nutritional values for Papaya Powder, granules and sheet made from Fresh Green Papaya. Values were obtained by AGRI Science Laboratories, Cerritos, California in 1983.

	Powder & Granules	Sheets
Papain	300,000 units of activity/gram	240,000 units of activity
Moisture	6.1%	16.8%
Crude Protein (1.13 N x 6.25)	7.06%	4.56%
Crude Fat	8.5%	5.1%
Crude Fiber	7.4%	2.1%
Ash (mineral matter)	4.9%	4.2%
Calories	398.5/100g	341.5/100g
Carbohydrates	73.4% per 100 gram	69.3%

The typical nutrition values shown below are for 100 gms of dried papaya powder or granules and for 100 gms of sheet.

The values were extrapolated from typical values for the edible portion of fresh wet papaya developed by Wenkam & Miller (1965).

	Powder & Granules	Sheets
Calcium	154.9mg	99.67mg
Phosphorus	60.1mg	38.67mg
Iron	0.98mg	0.63mg
Vitamin A	56.62µgm	36.43µgm
Thiamine B1	0.14mg	0.09mg
Riboflavin B2	0.22mg	0.14mg
Niacin	1.71mg	1.01mg
Ascorbic Acid C	435.1mg	280. mg

Green Papaya Powder, Carrot Powder, Psyllium Husks Ground, Apple Pectin, Guava Puree, Lime Concentrate

- Green Papaya Powder contains Vitamins A, C, E, and B factors. Green papaya is the only known food containing the enzyme, papain. Papain is a powerful digestive enzyme which helps digest proteins, carbohydrates and fats.
- The balance of the powder is made up of carrot powder, psyllium husks, ground, and apple pectin. This combination of ingredients, mixed together, makes the finest fiber product on the market.
- Formulated by: Enzyme Beauty Products of Hawaii
  A joint venture with Papaya Products of Hawaii

Suggested Use:

- 1 teaspoon per meal.

Sprinkle over cereal, salads, or other food.

ALL NATURAL

HAWAIIAN FIBER

100% PURE

NET WT. 8 OZ. - 226.8 GRAMS

MADE IN HAWAII BY:

PAPAYA PRODUCTS OF HAWAII

KEAAU, HAWAII 96749

Green Papaya Powder, Guava Puree, Lime Concentrate

- Green Papaya is the only known food containing the enzyme papain.
- Valuable source of vitamins A,C,E, and B factors.
- Excellent aid in digestion of protein, carbohydrates, and fat.
- Green Papaya Powder helps cleanse the intestinal walls of all waste matter in the form of excessive mucus and dead tissue.

Suggested Use:

1 teaspoon per meal. Mix into Smoothies; sprinkle over cereal or other food. Experiment!

A NATURAL
DIGESTIVE AID

GREEN PAPAYA POWDER

100% PURE

NET WT. 8 OZ. - 226.8 GRAMS

MADE IN HAWAII BY:

PAPAYA PRODUCTS OF HAWAII

KEAAU, HAWAII 96749

DATE FILMED

3/22/94

END