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POSTHARVEST INSTITUTE FOR PERISHABLES

A SOLAR DRYER WITH SUPPLEMENTAL HEAT
FOR FOOD PRESERVATION

A Short Course

Presented by
The Postharvest Institute for Perishables

In Collaboration With
Sam Ratulangi University
and
Washington State University

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University of Idaho

in cooperation with
**United States Agency for
International Development**

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A Short Course
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The Postharvest Institute for Perishables
University of Idaho
Moscow, Idaho

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Manado, Indonesia

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Indonesia Project EIAEP
Pullman, Washington

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I. Executive Summary

Rector W.I Waworoentoe, on behalf of the University of Sam Ratulangi (UNSRAT), and the Consortium of Eastern Island Universities, Manado, Indonesia, requested assistance from the U.S. Agency for International Development Mission in Jakarta in preserving food using a solar dryer with supplemental heat. USAID/Jakarta, via cable Jakarta 14260 (1983), requested that the Postharvest Institute for Perishables (PIP) at the University of Idaho provide the appropriate assistance.

In response to this request, Drs. Larry A. Branen and Louis E. Riesenberg and Mr. Kenneth D. Hoyt from the University of Idaho College of Agriculture were contracted by PIP to develop the training course on "Food Preservation Using a Solar Dryer with Supplemental Heat" in collaboration with Washington State University, UNSRAT, and the Consortium of Eastern Island Universities, at Manado, Indonesia, from December 5 through December 16, 1983.

The in-country program was conducted in two phases. Thirty-two participants, representing thirteen institutions, were enrolled in the short course.

The first phase of the program, one week in duration, involved the construction of one solar dryer with supplemental heat. Also, equipment and facilities were obtained in preparation for the course.

The second phase of the program extended from December 5 to December 16, 1983. During the first week, lectures and discussions on food preservation, and solar dryer construction and operation were conducted daily in the morning hours. Afternoon seminars consisted of "hands-on" laboratory experiences. Laboratory sessions addressed methods of food preservation and dryer construction and operation. Two additional dryers were constructed by the participants during this phase of the training.

During the second week, the participants designed food trials with the dryers for the purpose of: 1) studying food and dryer variables being measured, 2) doing drying trials on at least three foods, and 3) evaluating foods and preparing a report of the results.

The consulting training team perceived a genuine interest by the participants and university and governmental leadership in the concept of food preservation using a solar dryer with supplemental heat. Participants had

adequate backgrounds, interests and understanding of the concepts of food science and agricultural mechanization as applied to appropriate technology.

Participants rated the course highly for potential future use and indicated that they planned further research on dryer design and modifications. Many also indicated other commodities such as grains and cereals would be studied.

The team believes that additional follow-up activities by the Postharvest Institute for Perishables, USAID, and BKS University will be needed to assure continuation of the activities.

II. Introduction

A request to provide the short course "Food Preservation Using a Solar Dryer with Supplemental Heat" was received by the Postharvest Institute for Perishables at the University of Idaho from USAID/Jakarta via cable Jakarta 14260 (1983). The request was initiated by Rector W.I. Waworoentoe on behalf of the University of Sam Ratulangi, Manado (UNSRAT) and the Consortium of Eastern Island Universities. The request sought technical assistance and instruction in the construction and use of a solar dryer.

In response to this request, a short course "Food Preservation Using a Solar Dryer with Supplemental Heat" was presented at UNSRAT, Manado during December 5-16, 1983.

The team of Drs. Larry Branen and Lou Riesenber, and Mr. Ken Hoyt from the University of Idaho College of Agriculture was contracted by the Postharvest Institute for Perishables to present the short course.

The outline of the course presented is attached. During the period of November 19 through December 16, 1983, a solar dryer with supplemental heat was constructed on site by Riesenber and Hoyt. Materials and tools for construction of this dryer and subsequent dryers were purchased locally in Manado. Additionally, food and materials necessary for food preparation were purchased locally during the week prior to the initiation of the course.

II. Food Preservation Course

The course began on December 5, 1983. During the first week, lectures and discussions on food preservation and solar dryer construction and operation were conducted daily in the morning hours. Afternoon seminars consisted of "hands-on" laboratory experiences. The group was divided into two sections and two simultaneous laboratory sessions were held. One laboratory session dealt with methods of food preservation while the other dealt with dryer construction and operation. In the mid-afternoon the laboratory groups were rotated so all participants received training on dryer construction and food preservation.

The food preservation laboratories made use of the solar dryer constructed by the team. The initial laboratories provided information on moisture analysis, food preparation and the monitoring and operation of the dryer. Several fruits were prepared, dried and packaged. A dehydration curve was prepared to acquaint students with dryer operation. Evaluation techniques for dried foods were demonstrated in the second laboratory while preparation of dried fruits and vegetables was demonstrated in the third and fourth laboratories.

The dryer construction laboratory resulted in the construction of two additional dryers. The coach-pupil method of instruction was used in the four major areas: dryer construction, cabinet construction, firebox construction and solar collector construction. All three dryers used kerosene burners as supplemental heat sources.

During the second week, the participants were divided into three groups. Each group designed two food trials with each group assigned to one of the three dryers. One group dried vegetables, the second fruit and the third meat and fish. Each group was asked to design its experiments, to indicate the food and dryer variables being measured, do drying trials on at least three foods in two trials, evaluate foods and present and prepare a formal report of results. Groups prepared foods during the morning sessions and discussed results and monitored drying of foods in the afternoon. On the concluding day of the short course, each group leader orally presented the results and provided a formal written report.

The following foods were dried during the trials: salak, papaya, mango, kedondong, fish, beef jerky, beef, bananas, green beans, snow peas, radish, chili peppers, cabbage, tomatoes, cassava, carrots, and liver. Each group tried different pretreatments including sodium bisulfite or blanching of fruits and vegetables and salt and/or acid treatment of meat and fish. The groups closely monitored solar energy and kerosene use during drying. Participants were totally responsible for management of the dryers. The groups calculated moisture loss and made sensory evaluation of all products. The latter evaluations indicated excellent acceptance of the dried foods prepared. Differences were noted in pretreatment with steam blanching preferred for vegetables, sulfite treatment preferred for fruits and salt and citric acid treatment preferred for fish.

The participants were able to manage the dryers effectively including the use of supplemental heat. They appeared to like the use of supplemental heat and accepted it as an integral part of the dryer. They did make several recommendations regarding the use of alternate supplemental heat sources, e.g. charcoal, coconut main stems, wood and other renewable energy sources. Other possible applications of the dryer concept were recognized in the group reports. Some of the possibilities were the drying of copra, rice, and spices.

During the conclusion of the short course, technology transfer and outreach programs were discussed. Major issues such as goal setting, ways and means, alternate construction materials, the will of the people, economics and accessibility of products were stressed. Several of the participants expressed a desire to conduct additional courses in food preparation via solar drying for the rural poor - some indicating programs would be conducted through their church groups, others through educational institutions. The class, as a whole, was instructed by the First Lady (Governor's wife) to provide training to the rural poor. Additionally, the First Lady instructed PKK University to begin a food preservation with solar drying course in February, 1984.

In the short course were 32 participants representing thirteen institutions as follows: UNSRAT Manado (19), IKIP Manado (3), Hasanuddin Ujung Pandang (1), IKIP Ujung Pandang (1), Tadulako Palu (1), Halu Oleo Kendari (1), Pattimura Ambou (1), Mulawarman Samarinda (1) Cendrawasih Irian Jawa (1), Dinas Partanian Sulut (1), Perendustrain Kanwil Sulut (1), Peneliti dan Pengembangan Industri Balai (1), and UNLAN (1). Disciplines represented by the participants were varied and included agriculture, engineering, fisheries, medicine, education, home economics, mathematics, climatology, soils, agronomy, animal sciences, food science, and religion.

III. Conclusion

At the conclusion of the short course, participants were asked to complete a training evaluation questionnaire. In Part I, the participants were asked to rate major portions of the short course on a scale of 1 to 5 with 1 being

not useful and 5 being very useful. The participants were also encouraged to make specific comments on the usefulness of the short course. Part II of the questionnaire included additional questions regarding the participant's anticipated future use of the short course experiences. A copy of the instrument and the summary is attached.

Ratings averaged 4.58 or higher on all questions. Major comments on Part II indicated participants planned further research on dryer design and modifications with a major emphasis on use of low-cost construction materials and other less expensive sources of supplemental heat. Many indicated other commodities such as grains or cereals would be studied. The majority of the participants indicated follow-up activities on food drying and dryer construction would be initiated in the villages.

The team perceived a genuine interest by the participants and university and governmental leadership in the concepts of food preservation with solar drying with supplemental heat. Participants had an adequate background, interest and understanding of the concepts of food science and agricultural mechanization as applied to appropriate technology. Participants appeared to enjoy discussion activities especially when group interaction was possible. Most appeared capable of understanding the presentations which were made in English.

The team appreciates the invaluable assistance rendered by Mr. Bob Haggerty, Associate Advisor of WSU-BKS Association. Mr. Haggerty's help in translation, procurement of food and materials, day-to-day management of the course, interpretation of social mores for the team and other general assistance aided immeasurably to the success of the short course.

The laboratory facilities provided were adequate for the course at the level presented. However, if further research studies on food preservation and dryer construction are initiated, improved facilities will be needed.

The team anticipates further activities regarding dryers by the participants in several areas:

1. Research on dryer construction with an emphasis on lowering the cost of the dryer and developing new supplemental heat sources.
2. Research on food preservation with an emphasis on extending the use of the dryer to other food products.

3. Use of the dryers, and dryer and food preservation concepts in formal and non-formal courses of instruction.
4. Use of the concepts in training villagers and farmers in dryer construction and food preservation.

The team believes that additional follow-up activities by the Postharvest Institute for Perishables, USAID and BKS University will be needed to assure continuation of the activities with adequate planning and follow-through.

Beyond the needs of this specific project, the team recognizes needs within the Eastern Islands as:

1. technology of charcoal manufacturing,
2. technology of canning, heating, cooling and other food preservation techniques,
3. food analysis techniques and procedures,
4. methods of mycotoxin analysis,
5. basic skills in agricultural mechanization for project construction and modification; these skills and appropriate facilities and equipment should be available to faculty and staff in agriculture,
6. use of solar, wind and biogas energy for other agricultural processing, and
7. applied research design and experimentation.

TRAINING AGENDA

FOOD PRESERVATION - SOLAR DRYING WITH SUPPLEMENTAL HEAT

DAY 1 8:30 AM

Lecture-Discussion
Sessions

1. Opening Ceremonies
2. Overview of Course
- Branen & Riesenberq
3. Methods of Food Preservation
- An Overview
- Branen
4. Drying as a Preservation Method
- Branen
5. Solar Drying - An Overview
- Riesenberq

1:30 PM

Lab Sessions

1. Methodology of Food Drying
- Branen
2. Dryer Cabinet Construction
- Hoyt and Riesenberq

Both groups rotate at midpoint of sessions

DAY 2 8:30 AM

Lecture-Discussion
Sessions

1. Fundamentals of Drying
- Riesenberq
2. Food Properties and Moisture
Extraction
- Branen

1:30 PM

Lab Sessions

1. Evaluation of Dried Foods
- Branen
2. Complete Cabinet and Firebox
- Hoyt and Riesenberq

Both groups rotate at midpoint of sessions

DAY 3 8:30 AM

Lecture-Discussion
Sessions

1. Solar Collector Principles
- Riesenbergr
2. Preparation of Foods for Drying
- Branen

1:30 PM

Lab Sessions

1. Preparation of Dried Fruits
- Branen
2. Solar Collector Construction
- Hoyt and Riesenbergr

Both Groups rotate at midpoint of
sessions

DAY 4 8:30 AM

Lecture-Discussion
Sessions

1. Evaluation of Some Existing Solar
Dryers
- Hoyt
2. Packaging and Storage of Dried
Foods
- Branen
3. Orientation of Solar Dryer for
Maximum Efficiency
- Riesenbergr

1:30 PM

Lab Sessions

1. Preparation of Dried Vegetables
- Branen
2. Complete Dryer Construction
- Hoyt and Riesenbergr

Both groups rotate at midpoint of
sessions

DAY 5 8:30 AM

Lecture-Discussion
Sessions

1. Use of Dried Foods
- Branen
2. Supplemental Heat Sources
- Riesenbergr
3. Summary and Evaluation of
Week's Activities

1:30 PM

1. Labs Open For Individual
Instruction

Lab Sessions

2. Evaluation of Dried Fruits and Vegetables
3. Complete Solar Dryer Details

DAY 6 8:30 AM

Lecture-Discussion Sessions

1. Nutritional Values of Dried Foods
- Branen
2. Experimental Design of Drying Trials
 - a. Food parameters
 - b. Dryer parameters- Branen and Riesenber

1:30 PM

Lab Sessions

1. Total group divided into 3 representative subgroups
2. Selection of Food and Dryer Parameters for Drying Trials
- Branen
- Hoyt and Riesenber

DAY 7 8:30 AM

Lab Sessions All Day
Same grouping as preceding day.

1. Preparation of Foods for Drying Trials
2. Initiate Trials
3. Conducting Trials

DAY 8 8:30 AM

Lecture-Discussion Sessions

1. Drying Procedures Specific to Fruits and Vegetables
- Branen
2. Drying Procedures Specific to Other Food Commodities
- Branen

Lab Session
previous three groups

1. Evaluation of Drying Trial 1

1:30 PM

Lab Session

2. Initiate Drying Trial 2

DAY 9 8:30 AM

1. Technology Transfer and Outreach

Lecture-Discussion
Sessions

- Hoyt

1:30 PM

1. Evaluation of Previous Storage Procedures
- Branen

Lab Sessions

2. Evaluate Drying Trial 2

DAY 10 9:00 AM

1. Summary of Course
 - a. Food Technology
- Branen
 - b. Dryer Technology
- Riesenber
2. Course Evaluation by Participants

Lecture-Discussion
Sessions

PM

1. Graduation Ceremony
- Certificate Presentation

APPENDIX 2

TRAINING EVALUATION QUESTIONNAIRE

This questionnaire provides us with ongoing information useful for increasing the effectiveness of the training. We appreciate your thoughtful consideration in making specific comments indicating why an activity was useful or was not as useful as it might have been.

List training activities in the order indicated by your instructor. Next rate their usefulness by circling a number on the scale.

We encourage you to make any comments that you choose. Thank you !

	<u>Not Useful</u>		<u>Moderately Useful</u>		<u>Very Useful</u>
	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>
	1	2	3	4	5
1. <u>Principles of Food Preservation</u> Comments :	1	2	3	4	5
2. <u>Principles of Dryer Construction of operation</u> Comments :	1	2	3	4	5
3. <u>Technology Transfer of outreach</u> Comments :	1	2	3	4	5
4. <u>Food Preservation Laboratory Sessions</u> Comments :	1	2	3	4	5
5. <u>Dryer construction sessions</u> Comments :	1	2	3	4	5
6. <u>Food Drying Trials</u> Comments :	1	2	3	4	5
7. <u>Assistance to Individual Needs</u> Comments :	1	2	3	4	5
8. _____ Comments :	1	2	3	4	5
9. _____ Comments :	1	2	3	4	5
10. _____ Comments :	1	2	3	4	5
11. _____ Comments :	1	2	3	4	5

1. Prinsip pengawetan makanan
2. Prinsip konstruksi alat pengering dan pemakaiannya (operasinya)
3. Teknologi pengalihan & out reach
4. Sesion laboratorium pengawetan makanan
5. Sesion konstruksi alat pengering
6. Jalur pengeringan makanan
7. Bantuan untuk kebutuhan individu
8. Apakah engkau merencanakan memakai informasi yang didapat dalam latihan ini ?
9. Apakah engkau berhasrat membuat & memakai alat pengering dari enersi surya dengan tambahan panas ?
Jelaskan !
10. Apakah engkau merencanakan suatu riset pengeringan makanan dengan menggunakan tambahan panas ? Jelaskan !
11. Apakah engkau merencanakan suatu kegiatan outreach untuk pedesaan atau petani.
 - a. dengan konstruksi alat pengering ?
 - b. dengan pengeringan makanan.
12. Uraikan/berikan rencanamu yang lain yang berhubungan dengan pengeringan menggunakan tambahan panas & enersi surya.
13. Adakah kebutuhan untuk lanjutan latihan ini.
 - a. pada pengeringan dengan menggunakan enersi matahari
 - b. lain-lain area pengawetan makanan
 - c. dalam area dari pertanian atau teknik.

