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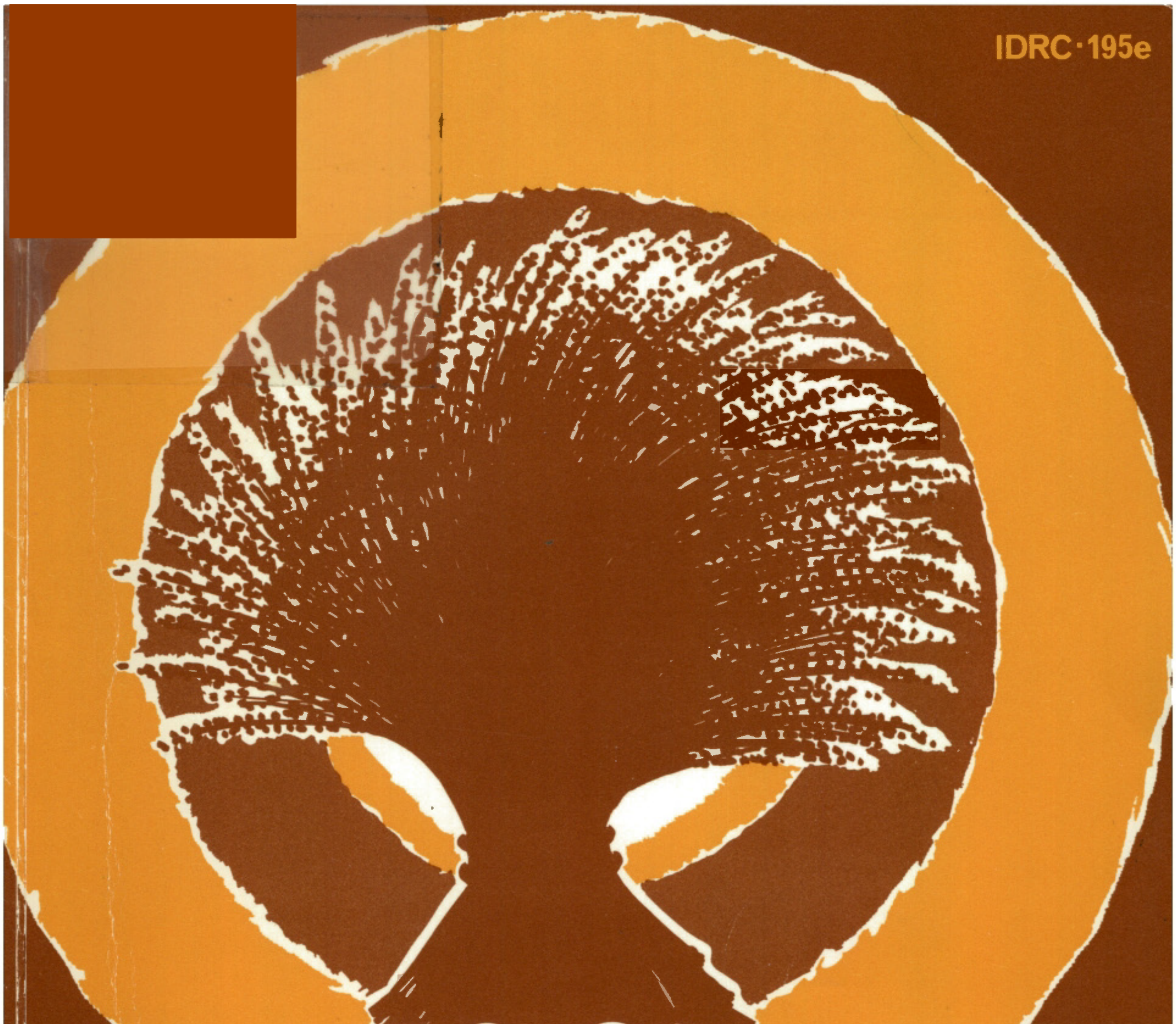

FOOD DRYING

Proceedings of a Workshop
Held at Edmonton, Alberta, 6-9 July 1981

The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences, and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa

Yaciuk, G.

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Food Drying

Proceedings of a workshop held at Edmonton Alberta, 6–9 July 1981

Editor: Gordon Yaciuk

Sponsored by
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Edmonton, Canada

Abstract/Résumé/Resumen

The authors of this volume include researchers and scientists from many countries that encompass diverse climatic, geographic, and socioeconomic conditions. Their disciplines were also numerous: home economics, food science, nutrition, physics, and engineering.

The workshop covered the most important areas in the design and operation of a drying system. These are: drying requirements, consumer acceptance, heat and mass transfer, and heat sources. Within drying requirements, the need for drying the product is discussed as well as drying times and rates, sample preparation, quality changes during drying, rehydration problems, and problems with storage of the dried product. The section on consumer acceptance includes the effects of drying on the nutritive value of food, the introduction of a dried food to the consumer market, and how consumers provide valuable information to scientists to help in improving a process or product. The theory and design of a drying chamber and process control are explained under heat and mass transfer and an operational, full-scale drying system is examined. Finally, under heat sources, a number of examples are given in the use of the sun, petroleum products, agriculture wastes, and wood as heat sources for a drying process. A final concluding commentary is made on the overall recommendations derived from the workshop and proposals for future work are given.

Les auteurs de ce volume sont des chercheurs et des techniciens venus de pays très différents les uns des autres du point de vue climat, géographie et conditions socio-économiques. Les disciplines représentées étaient aussi très diverses: économie domestique, alimentation, nutrition, physique, génie mécanique.

Le colloque a examiné les questions les plus importantes en ce qui concerne la conception et l'utilisation d'une installation de séchage: besoins en matière de séchage, l'accueil du consommateur, transmission de la chaleur et évacuation de l'humidité, sources de chaleur. Le chapitre sur les besoins en matière de séchage traite de la nécessité et de la durée de cette opération, de la préparation des échantillons, de l'action du séchage sur la qualité du produit, des problèmes de réhydratation et des problèmes de stockage du produit sec. Le chapitre sur l'accueil du consommateur traite des effets du séchage sur la valeur nutritive du produit, de la commercialisation d'un produit sec et de l'aide que peuvent apporter les consommateurs à l'amélioration d'un procédé ou d'un produit. Le chapitre sur la transmission de la chaleur et l'évacuation de l'humidité traite de la théorie et de la conception d'un séchoir, des modes de réglage et décrit une installation en service. Enfin, le chapitre sur les sources de chaleur donne des exemples l'utilisation du soleil, des produits pétroliers, des déchets agricoles et du bois. Un exposé des conclusions dégagées par le colloque et de ses recommandations est présenté à la fin de l'ouvrage.

Los autores de este volumen comprenden investigadores y científicos de varios países que, en conjunto, abarcan diversas condiciones climáticas, geográficas y socio-económicas. Sus disciplinas respectivas también son numerosas: economía del hogar, ciencias de alimentación, nutrición, física e ingeniería.

El cursillo abarcó los aspectos más importantes en el diseño y operación de un sistema de deshidratación. Estos son: requisitos de la deshidratación, aceptación por el consumidor, trasferencia de calor y masa y fuentes de calor. Entre los requisitos se examina la necesidad de deshidratar el producto así como los tiempos e índices del proceso, preparación de muestras, cambios en calidad durante le deshidratación, problemas que presenta la rehidratación y problemas resultantes del almacenamiento del producto deshidratado. La sección de aceptatión por el consumidor comprende los efectos de la deshidratación sobre el valor nutritivo del alimento, la introducción de un alimento deshidratado en el mercado del consumidor, y como éstos a su vez proveen información valiosa a los científicos ayudándoles a mejorar un proceso o producto. Se explican la teoría y diseño de la cámara de deshidratación y el proceso de controlbajo trasferencia de calor y masa, examinándose un sistema operativo de deshidratación a escala comercial. Finalmente, y bajo el concepto de fuentes de calor, se citan varios ejemplos relacionados con el uso del sol, de productos petrolíferos, y desechos agrícolas, así como el de la madera como fuentes de calor para procesos de deshidratación. Se efectua un comentario final sobre recomendaciones generales derivadas del cursillo al tiempo que se efectúan propuestas para el trabajo futuro.

Contents

Foreword

For as long as we have historical record, the heat of the sun has been used to dry cereal grains, vegetables, fruit, fish, and meat. Solar radiation is widely used as a direct source of energy by which to dry and dehydrate foods of many kinds in many countries. As fossil fuel costs continue to rise, direct and indirect solar drying will gain increasing importance as a method of food preservation throughout the world.

The International Development Research Centre (IDRC) is supporting several research projects in which solar radiation alone or together with combusted agricultural wastes is used to dry crops and other food materials, in several of which the influence of variable drying conditions upon nutrient retention is being studied.

Because the food dehydration and crop drying projects financed by IDRC are located in countries with widely different environmental conditions and the spectrum of research activities calls for a variety of scientific disciplines, it appeared desirable to bring together research workers representative of the geographic and scientific diversity involved.

A workshop was, therefore, organized from 6 to 9 July 1981, at the University of Alberta and in collaboration with the Alberta Department of Agriculture (ADA), which included 2 days of formal sessions; a 1-day tour organized by the ADA of a grain dryer manufacturing plant, a local farm, and a primary elevator; and 1 day of informal visits to various university departments and commercial organizations by individual participants. Those attending the workshop came from Bangladesh, Chile, Egypt, Guatemala, India, Indonesia, Kenya, Korea, Malaysia, Mali, Niger, Costa Rica, Peru, the Philippines, Sierra Leone, Singapore, Thailand, and Zambia, encompassing immensely diverse climatic, geographic, and socioeconomic conditions and with experience that embraced home economics, food science, nutrition, physics, and engineering. The main topics covered included drying requirements, consumer acceptance, heat and mass transfer, and heat sources. This publication comprises the papers presented and discussed, together with a commentary by the technical coordinator of the meeting.

It is the belief of my colleagues in the Agriculture, Food and Nutrition Sciences (AFNS) Division that, thanks to the contributions by those who took part, this publication may prove of lasting value to others in developing countries who share similar interests and concerns.

J.H. Hulse
Director
Agriculture, Food and Nutrition Sciences Division

Participants

A. Alam, Post-Harvest Technical Scheme Project Co-ordinator, Central Institute of Agricultural Engineering, Shri Guru Tegh Bahadur Complex, T.T. Nagar, Bhopal 462 003, India.

Hatem Mohamed Ali, Head, Laboratory on Animal and Poultry Nutrition, National Research Centre, Dokki, Cairo, Egypt.

Silvestre C. Andales, Assistant Professor and Project Leader, UPLB/IDRC Postharvest Project, Department of Agricultural Process Engineering, University of the Philippines at Los Baños, College, Laguna 3720, Philippines.

M. Zohadie Bardaie, Department of Agricultural Engineering, Universiti Pertanian Malaysia, Serdang, Selangor, Malaysia.

Michael W. Bassey, Department of Mechanical Engineering, Fourah Bay College, University of Sierra Leone, Freetown, Sierra Leone.

Ernesto V. Carpio, Project Engineer, Department of Food Science and Technology, University of the Philippines at Los Baños, College, Laguna 3720, Philippines.

Teoh Inn Chek, Lembaga Padi Dan Beras Negara, Tingkat 20–21, Bangunan UMBC, 4, Jalan Sulaiman, Kuala Lumpur, Peti Surat 108, Malaysia.

Chong Thean Chhong, Chemical and Food Process Section, Singapore Institute of Standards and Industrial Research, Maxwell P.O. Box 2611, Singapore 9046, Republic of Singapore.

J.M. Degbe, Office national de l'énergie solaire, B.P. 621, Niamey, Niger.

Dante B. de Padua, Technical Team Leader, Southeast Asia Cooperative Post-Harvest Research and Development Programme, c/o SEARCA, College, Laguna 3720, Philippines.

W. Edwardson, Senior Program Officer, Agriculture, Food and Nutrition Sciences Division, International Development Research Centre, 10454 Whyte Avenue, Suite 304, Edmonton, Alberta, Canada.

R.S. Forrest, Associate Director, Engineering and Home Design Sector, Alberta Department of Agriculture, Agriculture Building, 9718 107 Street, Edmonton, Alberta, Canada.

Ricardo García, Engineer, Applied Research Division, Instituto Centroamericano de Investigación y Tecnología Industrial, Avenida La Reforma 4–47 Zone 10, Apartado Postal 1552, Guatemala, C.A.

Celsa Lastreto Gomez, Centro de Investigaciones on Tecnología de Alimentos, Universidad de Costa Rica, San Jose, Costa Rica.

M.I. Gomez, Lecturer, Department of Food Science and Technology, Faculty of Agriculture, University of Nairobi, P.O. Box 29053, Kabete, Nairobi, Kenya.

H.K. Koh, Associate Professor, Division of Agricultural Machinery and Process Engineering, Department of Agricultural Engineering, College of Agriculture, Seoul National University, Suweon, Korea 170.

Carlos Lescano, Jefe, Departamento de Tecnologia de Alimentos y Productos Agropecuarios, Universidad Nacional Agraria La Molina, Apartado 456, Lima, Peru.

J. Lorenzana, Agricultural Engineering Department, Isabela State University, Echaque, Isabela, Philippines.

Joseph M. Mwale, Senior Scientific Officer, Food Technology Research Unit, National Council for Scientific Research, P.O. Box CH-158, Chelston, Lusaka, Zambia.

Candido Joven Miguel, Pasig Distributors Corporation, 114 Plaza Rizal, Pasig, Metro Manila, Philippines.

Tipvanna Ngarmsak, Department of Agricultural Products, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.

J.M. Olhagaray, Institute of Technological Research (INTEC/CHILE), Casilla 667, Santiago de Chile, Chile.

P.V. Prabhu, Scientist, Central Institute of Fisheries Technology, CIFT/IDRC Fish Processing Project, Willingdon Island, Matsyapuri P.O., Cochin 682 029, India.

Abdus Satter, Senior Scientific Officer, Agricultural Engineering, Bangladesh Agricultural Research Institute, Joydebpur, Dacca, Bangladesh.

O.G.A. Schmidt, Program Officer, Agriculture, Food and Nutrition Sciences Division, International Development Research Centre, 10454 Whyte Avenue, Suite 304, Edmonton, Alberta, Canada.

Sriwai Singhagajen, Chief, Storage and Processing Section, Agricultural Engineering Division, Department of Agriculture, Ministry of Agriculture and Cooperatives, Bangkhen, Bangkok 9, Thailand.

Wenceslao M. Sison, Agricultural Plans and Programs Supervisor/Project Leader, Technical Research and Services Directorate, National Food Authority, 101 E. Rodriguez Sr. Avenue, Matimyas Building, Quezon City, Philippines.

Sjachputra, c/o Haji Muslimin Nasution, Ministry of Co-operatives, Departemen Perdagangan Dan Koperasi, Sekretariat Menteri Muda Urusan Koperasi, P.O. Box 384, Jakarta, Indonesia.

Suahyadi, Project Leader, National Logistics Agency (BULOG), BULOG/IDRC Postharvest Rice Technology Project, P.O. Box 2345, Jakarta, Indonesia.

J.A. Sumardi, Departemen Pendidikan Dan Kebudayaan, Universitas Brawijaya, Proyek Kerjasama Unibraw/IDRC, Jalan Mayjen Haryono 169, Malang, Jatim, Indonesia.

Salomon Chavez Tapia, Departamento de Tecnologia Pesquera, Universidad Nacional Agraria La Molina, Apartado 456, Lima, Peru.

Cheick Oumar Traoré, Laboratoire de l'énergie solaire, B.P. 134, Bamako, Mali.

S. Vogel, Program Officer, Agriculture, Food and Nutrition Sciences Division, International Development Research Centre, 10454 Whyte Avenue, Suite 304, Edmonton, Alberta, Canada.

G. Yaciuk, Program Officer, Agriculture, Food and Nutrition Sciences Division, International Development Research Centre, 10454 Whyte Avenue, Suite 304, Edmonton, Alberta, Canada.

IDRC Staff

M.C. Beaussart, Administrative Assistant, Agriculture, Food and Nutrition Sciences Division, IDRC, 10454 Whyte Avenue, Suite 304, Edmonton, Alberta, Canada.

A. Chouinard, Technical Editor, Communications Division, IDRC, Box 8500, Ottawa, Ontario, Canada K1G 3H9.

K. Kealey-Vallière, Assistant Technical Editor, Communications Division, IDRC, Box 8500, Ottawa, Ontario, Canada K1G 3H9.

Drying Grapes in Northern Chile

J.M. Olhagaray[1]

Abstract. This paper reports the results on the drying of Thompson seedless grapes in Northern Chile. The work was carried out during the summer of 1978 by the Institute of Technological Research (INTEC/CHILE). The Thompson seedless grape is grown in the Valley of Copiapo River and is used mainly for export purposes as a fresh product. For variety and quality reasons only 70% of the production is exported, which leaves about 800 t of usable grapes discarded.

Apart from exhibiting very good ecological conditions for sun-drying fruits, the area is economically depressed, with a high percentage of unemployment. An adaptation of the Australian method of sun-drying grapes was considered as a solution to the problem. A drying rack prototype was built with a capacity of 1 t of fresh grapes. Drying runs were conducted during the summer of 1978. Results show the technical feasibility of drying the grapes by this method. An economic study was carried out that considered a facility for drying 300 t of fresh product. Results show a moderate investment, a good return, and a high requirement of hand labour.

The Valley of Copiapo River where Thompson seedless grapes are grown is an economically depressed area with high unemployment. The availability of the raw material consists of about 800 t (fresh) corresponding to 3000 t of table grapes for export (Thompson seedless). The region has adequate conditions for sun drying, but a drying system is needed that would be labour intensive, capable of being operated within a small area, easily constructed, and would not require liquid or solid fuels.

Procedure for Drying Unsulfured Grapes

In the procedure for drying unsulfured grapes, grape bunches are first collected and washed in cold water to remove dust and contaminants. The grape bunches are then caustic dipped (0.3% boiling lye solution). The dipping time ranges between 3 and 4 sec producing cracks in the skin, which speeds up the dehydration process. The grapes are then washed in cold water to stop the chemical attack and to avoid cooking the product. Another cold water dip is used to eliminate traces of lye from the grape skin. The grapes then go through a sulfuring process to develop a clear colour and prevent deterioration.

The grapes are then placed in racks (load 15 kg/m^2) and left to dry, starting by the upper floors. Protection against insects and small animals must be provided. Once dry, grape bunches are removed from the rack and stored in the shade for about 20 days.

The system characteristics are a drying rack with a total capacity of 1 t of grapes, a sulfur chamber made with sun-dried bricks with an inner cover of coal tar, and ancillary equipment consisting of 200-L drums, steel baskets, and a brick fireplace for the hot-dip drum.

Results of Drying Runs

Results of the drying runs indicated an average drying time of 16 days. The product characteristics are as follows: the average moisture content is 14.4% (wet basis), the deviation is 0.6%, and the average size is 6.5 mm. In the colour evaluation 52% of the sample exhibits were of a pale yellow colour (uniform), 36.5% were not of uniform colour, and 11% were pink coloured with dark yellow spots. The major defects included 14.5% with scars and a remaining SO_2 of 460 ppm. Evidence of mechanical damage, burns, moulds, insect damage, and dust was not detected. From 4.4 kg of unprocessed grapes the yield was 1 kg of raisins.

Results of Feasibility Study

The results of the feasibility study showed a base capacity of 300 t of fresh grapes per season,

[1]Institute of Technological Research (INTEC/CHILE), Casilla 667, Santiago de Chile, Chile.

raisin production of 70 t/season, and a land requirement of 2.5 ha. The total investment was U.S.$180 000, working capital was U.S. $20 000, the operation cost amounted to U.S.$41 700/season, the raisin price was an average of U.S.$1150/t (70% of total production is exported), there was a rate of return at 18%, and a labour requirement of 50 people.