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.
Food Drying

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

Editor: Gordon Yaciuk

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International Development Research Centre,
Ottawa, Canada

in collaboration with
Alberta Department of Agriculture,
Edmonton, Canada
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.
Contents

Foreword .................................................. 5
Participants ................................................ 6
Introduction
Theme and objectives of the workshop G. Yaciuk ................. 9
Drying Requirements
Drying of fish in India P.V. Prabhu and K.K. Balachandran ........ 11
Drying of vegetables in Egypt H.M. Ali and I.A. Sakr ............. 15
Drying of potatoes (papa seca) in Peru C. Lescano ................. 20
Drying of paddy in Indonesia Suahyadi .......................... 27
Consumer Acceptance
Effect of drying on the nutritive value of foods in Kenya M.I. Gomez ............................................. 31
Designing cowpea products for Northeastern Thailand T. Ngarmsak, M.D. Earle, and A.M. Anderson ................. 36
Consumer acceptance of dehydrated banana weaning food in Costa Rica Celsa Lastreto G., Rodney Cooke, and Armando Campos S. ................................................. 40
Marketing dried fish in East Java, Indonesia J.A. Sumardi, H. Purnomo, W.H. Susanto, Putiati, Darius, and I. Suryo ................................................................. 47
Heat and Mass Transfer
Drying of cereal grains in the Philippines S.C. Andales ............. 51
Drying onions in Niger A. Ba, Ch. Banzet, and J.M. Degbe ......... 61
Drying fish in the Philippines Ernesto V. Carpio ..................... 63
Drying grapes in northern Chile J.M. Olhagaray ..................... 71
Heat Sources
Solar energy as a heat source in crop drying in Sierra Leone Michael W. Bassey ............................................. 73
Solar and natural air drying of rough rice in Korea Hak Kyun Koh and Chang Joo Chung .................................. 81
Farm grain dryer — Thailand Sriwai Singhagajen .................. 89
Dryers for cooperatives for food production in Indonesia Sjachputra ................................................. 99
Conclusions
Commentary G. Yaciuk ....................................... 103
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.


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.


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 Centro-americano de Investigación y Tecnología Industrial, Avenida La Reforma 4-47 Zone 10, Apartado Postal 1552, Guatemala, C.A.

Celsa Lastreto Gomez, Centro de Investigaciones en 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.

Tipvama 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, Matsuapuri 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, Bangkok, 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.


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.
Consumer Acceptance

Marketing Dried Fish in East Java, Indonesia

J.A. Sumardi, H. Purnomo, W.H. Susanto, Putiati, Darius, and I. Suryo

Abstract. A marketing survey was made in a rural processing village and an urban market to identify important characteristics for marketing of dried fish in East Java. Both merchants and consumers were interviewed. It was found that dried gutted fish with low salt content was preferred by both merchants and consumers, although this was dependent on the species preferred. Merchants were concerned, however, about storage life of the dried fish presently available and thus became more critical with the length of the market chain. This information will guide the development of improved processing and drying technology, being carried out at the fishing village, as products with minimum salt content, consistent with adequate storage life, are sought.

In 1979, 53% of Indonesia’s total fish yield was produced in East Java. More than half of this was dried fish (33,856 t). Fish processing is not standardized and there is a wide variation in product quality. Consumption of processed fish varies from region to region and between the high and low socioeconomic classes. The availability of products on the market and their accessibility largely determine what the people will eat. Based on these facts, we undertook a survey of markets in East Java to determine, among other things, merchant and consumer preferences and perceptions. We felt the information would be valuable as a basis for the planning of improvements in processing methods.

Materials and Methods

We interviewed 34 merchants in dried fish stalls in the municipality of Malang (a consumer area) and in Muncar district (a producer area). About 25 consumers from each market area were also interviewed. Muncar has one market only, whereas Malang has one large market (Pasar Besar) and smaller markets in the districts around the city (Table 1). Merchants were asked to elaborate on the varieties of dried fish sold and their origin; buyers’ preferences; the reasons for those preferences; the quality of the dried fish and their shelf life; constraints in selling; and suggestions for product quality improvements. Consumers were asked how often they ate dried fish, how they prepared and served it, what type they preferred and why, how long the fish were usually kept before being eaten, and what was the longest amount of time they could safely be kept. A sample of dried fish was obtained from the stalls and the amount of salt it contained was determined by the Volhard method at the Unibraw/IDRC laboratory. The results were compared with comments by merchants about the saltiness of the products they sold.

Results and Discussion

Our results indicated that there were marked differences between the production area and the consumer area. Presumably, these reflected the availability of fresh fish and eating habits in the region.

In the production area (Muncar), almost all dried fish sold at stalls in the market are produced by small processors using very simple methods and equipment (Fig. 1). Sometimes, the stall owner is also the processor. There are also medium- and large-scale processors, but they also sell their products to merchants in large cities throughout Java (Fig. 2).

All the merchants in Muncar noted that they sold unsalted and slightly salted fish, because
these products have a better storage life than do heavily salted ones. The local consumers prefer to buy small species like teri (Stolephorus spp.), lemuru (Clupea spp.), tembang (Sardinella spp.), and cumi-cumi (Loligo spp.) as these are quite cheap. According to the merchants, consumers differentiate between the slightly salted fish by appearance. The slightly salted fish were compact and similar in colour to fresh fish; they were softer than heavily salted fish and their condition was more stable in all weather conditions. The heavily salted fish were very hard, whitish, and stale, and their condition changed according to the weather. The merchants felt the high salt content perhaps caused fish to absorb moisture.

To prevent losses caused by changes in the weather, the merchants said they dry the fish in the sun and store them in large containers to obtain good air circulation. Fish too large to be handled in this manner are hung at the front of the stall. The products are kept in the stall until purchased, the length of time varying between species, salt content, and processing. Tongkol (Euthynnus spp.) was usually sold within 2–4 weeks, whereas teri sometimes took more than 2 months to be sold.

The amount of dried fish sold daily in Muncar was a minimum of 2 kg and a maximum of 30 kg, the local people being the only consumers. Sales dropped markedly during the fresh fish season. The prices differed considerably between species, and these differences were recorded during the survey (Table 2).

The merchants do not know the salt content of the products they sell. Our analysis showed that all the products contained salt, although the merchants distinguished between the fish as unsalted, half-salted, and fermented (Table 3).

In contrast with the production area, the consumer area (Malang) has several markets.

![Fig. 1 A typical dried fish retail stall in the fishing village of Muncar, East Java.](image)
Table 2. The price of different species of dried fish sold in a small stall in Muncar during the survey.

<table>
<thead>
<tr>
<th>Species</th>
<th>Price (Rp/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>Slightly salted</td>
<td></td>
</tr>
<tr>
<td>Small sardine (Clupea spp.)</td>
<td>150</td>
</tr>
<tr>
<td>Cumii-2</td>
<td>650</td>
</tr>
<tr>
<td>Teri</td>
<td>400</td>
</tr>
<tr>
<td>Pari (Dasciatis spp.)</td>
<td>300</td>
</tr>
<tr>
<td>Heavily salted</td>
<td></td>
</tr>
<tr>
<td>Lemuru/sardine</td>
<td>125</td>
</tr>
<tr>
<td>Cumii-cumi</td>
<td>550</td>
</tr>
<tr>
<td>Teri</td>
<td>300</td>
</tr>
<tr>
<td>Bawal</td>
<td>250</td>
</tr>
<tr>
<td>Tongkol</td>
<td>300</td>
</tr>
<tr>
<td>Semenit/small sardine (Clupea spp.)</td>
<td>75</td>
</tr>
</tbody>
</table>

*Rp 630 = U.S. $1.00.

Dried fish marketing radiates from Pasar Besar, a large market where the merchants are primarily wholesalers who receive their products from outside and sell them to retailers operating in the smaller markets, named according to the districts in which they reside. The number of retailers varies in each market and depends on the main activities of the market. Most dried fish sold in Malang come from production areas in East Java, although a few come from Sumatra and Kalimantan (Table 4).

The processed fish kurisi (Holocentrum spp.) and janggalak (Saurida spp.) either unsalted or slightly salted are the favourites, according to the retailers who noted that the most popular fish had good flavour, were attractive, had good texture, were not too salty, were properly dried when the fish were split, and could be stored for a reasonable length of time. The retailers also indicated that small fish like anchovies (Stolephorus spp.) and small sardines (Clupea spp.) are also popular mainly because of their low cost.

Of the 98 consumers interviewed, 44 (45%) preferred kurisi and janggalak. The rest commented that they liked all the species if the fish were not too salty, attractive (similar in appearance to fresh fish), split (except small species), and properly dried.

Handling by merchants depended on the origin, species, size, and saltiness of the fish. Usually, fish come from Madura, Probolinggo, and Pasuruan, where the medium-sized fish are gutted and split, and from Muncar and some other regions, where they are processed whole. Small fish such as teri/small sardines and tembang (Sardinella spp.) are always dried whole. Lemuru/sardines (Clupea spp.) from Muncar are sometimes gutted and beheaded and, if the freshness declines, they are dried with heavy salt contents.

Retailers (9 of 22) maintained that consumers prefer gutted fish because they are clean; 12...
Table 3. Salt and moisture content of dried fish in Muncar.

<table>
<thead>
<tr>
<th>Species</th>
<th>Handling</th>
<th>Classification</th>
<th>Salt content (%)</th>
<th>Moisture content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semenit</td>
<td>Whole fish</td>
<td>Unsalted</td>
<td>22.34</td>
<td>44.56</td>
</tr>
<tr>
<td>Kurisi</td>
<td>Gutting</td>
<td>Half salted</td>
<td>29.02</td>
<td>51.15</td>
</tr>
<tr>
<td>Tembang</td>
<td>Whole fish</td>
<td>Salted</td>
<td>30.89</td>
<td>48.04</td>
</tr>
<tr>
<td>Selar</td>
<td>Whole fish</td>
<td>Salted</td>
<td>32.91</td>
<td>45.85</td>
</tr>
<tr>
<td>Layang</td>
<td>Whole fish</td>
<td>Fermented</td>
<td>37.29</td>
<td>49.55</td>
</tr>
<tr>
<td>Selar</td>
<td>Whole fish</td>
<td>Fermented</td>
<td>37.59</td>
<td>48.78</td>
</tr>
<tr>
<td>Kurisi</td>
<td>Whole fish</td>
<td>Salted</td>
<td>29.02</td>
<td>51.15</td>
</tr>
<tr>
<td>Kurisi</td>
<td>Gutting</td>
<td>Salted</td>
<td>31.67</td>
<td>48.57</td>
</tr>
</tbody>
</table>

\(^{1}\) Holocentrum spp.

Table 4. The variety of processed fish sold in Malang and their origin.

<table>
<thead>
<tr>
<th>Species</th>
<th>Processing method</th>
<th>Origin of products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemuru/sardine (Clupea spp.)</td>
<td>Salted dried</td>
<td>Muncar</td>
</tr>
<tr>
<td>Tembang (Sardinella spp.)</td>
<td>Salted dried</td>
<td>Muncar</td>
</tr>
<tr>
<td>Layang (Decapterus spp.)</td>
<td>Salted dried</td>
<td>Muncar</td>
</tr>
<tr>
<td>Teri (Stolephorus spp.)</td>
<td>Unsalted dried/half salted</td>
<td>Muncar</td>
</tr>
<tr>
<td>Kurisi (Holocentrum spp.)</td>
<td>Salted dried</td>
<td>Muncar, Tuban, Probolinggo</td>
</tr>
<tr>
<td>Gulmah (Otolithoides spp.)</td>
<td>Unsalted/half salted salted dried</td>
<td>Pasuruan, Sumatera</td>
</tr>
<tr>
<td>Janggala (Saurida spp.)</td>
<td>Salted dried</td>
<td>Gresik, Madura</td>
</tr>
<tr>
<td>Kerong-2 (Therapon spp.)</td>
<td>Fermented dried</td>
<td>Pasuruan, Probolinggo, Madura</td>
</tr>
<tr>
<td>Banyar (Rastreigler spp.)</td>
<td>Salted dried</td>
<td>Madura</td>
</tr>
<tr>
<td>Selar (Caranx spp.)</td>
<td>Salted dried</td>
<td>Madura</td>
</tr>
<tr>
<td>Bang-2 an (Lutjanus spp.)</td>
<td>Half salted dried</td>
<td>Pasuruan, Probolinggo, Madura</td>
</tr>
</tbody>
</table>

noted that the gutted and split fish are preferred because they are clean, properly dried, not too salty, and have a reasonable storage life. Five of the six wholesalers who bought and sold 100–300 kg fish a week supported this information.

Of the 98 consumers surveyed, 46 preferred gutted fish, and 32 liked good quality whole fish better. Only 20% of the consumers preferred split fish. A majority (63%) noted that they prepared the dried fish by frying in hot oil, about 4% cooked the fish with pulpy vegetables, about 12% cooked them with coconut, and about 21% put them together with other items as side dishes. The frequency of consumption was about 11% daily, 74% more than 1 day/week, and about 15% only a few days per month. Amounts were 0.25–1 kg/week. Most of the consumers ate the fish the same day they were purchased, although some kept them for 2–5 days.

None of the fish was completely unsalted; all were processed with at least small amounts of salt. The fish classified as salted were considered to have high concentrations of salt. All of the retailers sell the “unsalted” and salted dried fish.

High salt concentrations according to the retailers result in the fish becoming moist during damp weather and exhibiting white spots during dry weather due to recrystallization of the salt on the surface. The consumers do not like the very salty fish, and 3 of 22 retailers said they wipe the salt crystals off the fish using coconut husks moistened with water.

From the quality point of view, the retailers noted that lemurusardines (Clupea spp.) from Muncar suffer the most from rapid color changes (red or brown). The coloration was presumed to be caused by high fat contents. The gutted and beheaded products also deteriorate rapidly.

The retailers mentioned that the price was stable for a couple of months. The marketing volume decreases when large amounts of pindang (boiled fish) come to market and during the fresh fish season. The dried products, however, are affordable to consumers, especially dried teri (Stolephorus spp.) at Rp 300/kg and kurisi at Rp 800/kg. Most of the consumers buy the small fish because there are more fish in a kilogram.

This study indicated the need to design a salting and drying process with minimum salt content consistent with adequate storage life for the marketing systems on East Java.

Acknowledgment

We appreciate the guidance and advice of Dr. William Edwardson during our work. This is part of the Indonesian fish processing supported by IDRC.