URI Sea Grant Program

Reports on...

Fresh Fish Preservation: Hypobaric Storage

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There has been a decisive shift in seafood consumption in the U.S. from the frozen to the fresh state, and this trend is expected to continue. Economically, the goal for processors is to sell the majority of their product in its fresh state. A 20 cents per pound premium for fresh over frozen fish, as reported by the seafood press, can be a critical factor in surviving today's marketplace. Increasing demand from restaurants, supermarkets, and consumers for fresh, high-quality seafood and the limitations of conventional ice storage substantiates the value of a preservation technology such as hypobaric storage.

Researchers at URI used hypobaric storage, a special type of controlled atmosphere employing iced storage at low pressure (vacuum), to increase the storage stability of fresh lean fish. Depending on the pretreatment of fish, shelf life was extended by 50 to over 100 percent relative to that obtained by conventional ice storage.

Hypobaric storage has several real and potential benefits:

1. An extended shelf life without loss of quality. Fresh fish can remain stable for more than two weeks.

2. No additives, chemicals, gases, or preservatives are required. The gas composition is the same as air.

3. Expansion of markets. Shipping fresh fish under hypobaric conditions promotes development of fresh fish markets at considerable distances from the location of fish landing. For

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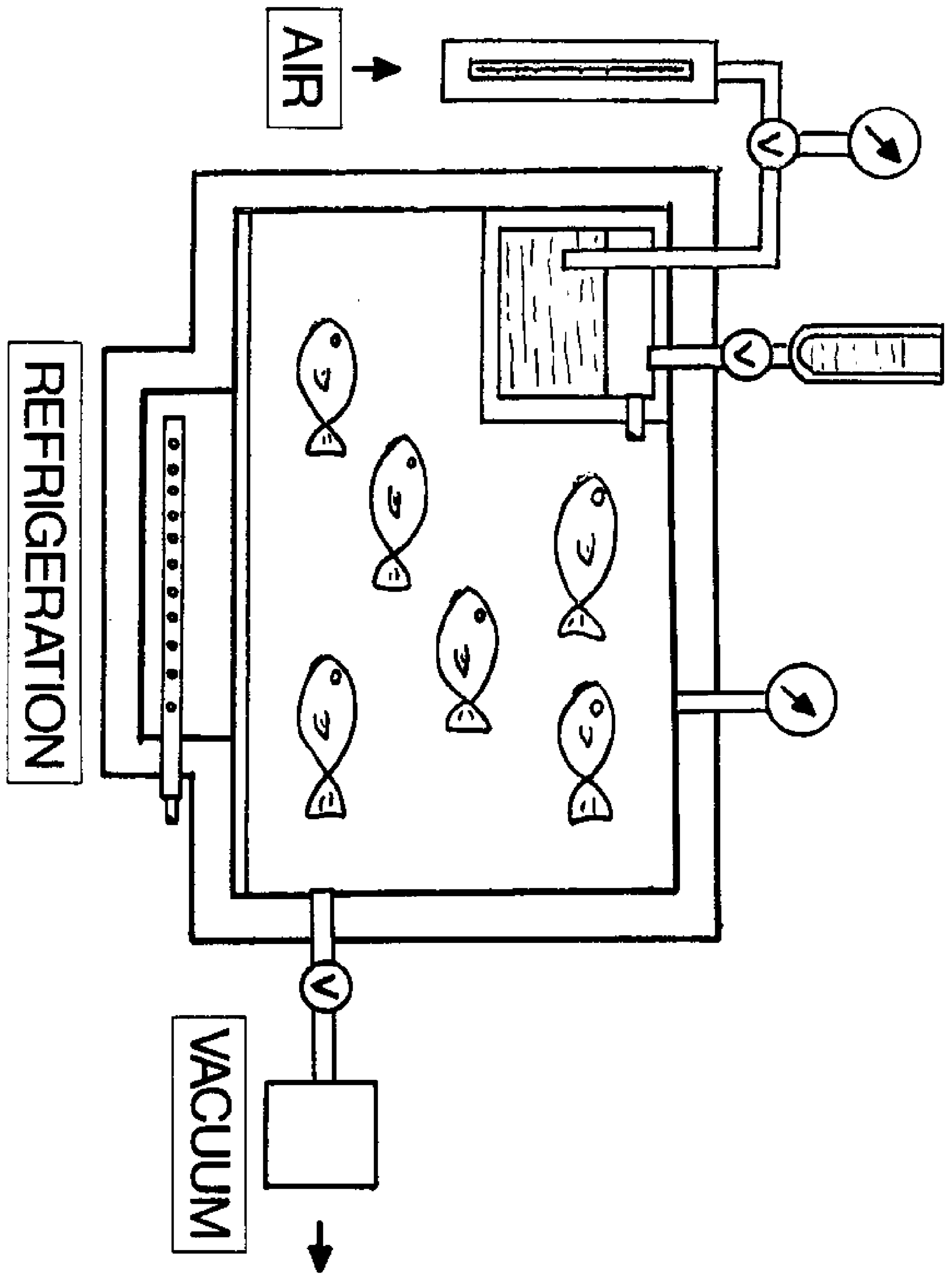


Diagram of Hypobaric Unit

example, there is a real demand for fresh fish in the Midwest. As reported by the seafood press, Midwest supermarkets have increased their seafood sales by as much as 50 percent over a year ago.

4. Adaptability. The hypobaric system can be designed for shipping and/or storage on a large or small scale, and it can be adapted to meet a variety of needs in processing, retail, or dockside operations.

5. Versatility. Hypobaric units have successfully transported and stored fresh meats, produce, and flowers. Therefore, the return trip can carry nonseafood commodities, under either hypobaric or refrigerated conditions, according to specifications of the commodity.

6. Reduced shipping costs.The higher price received for a high-quality fresh product can offset shipping costs.

7. Greater control over supply. The extended shelf life of the commodity provides greater control over supply.

8. Compatibility with handling procedures at sea. Boxed fish, layered in ice, maximizes the preservative effect of the hypobaric system. Consequently, the hypobaric system maintains the quality of the landed commodity from dockside to destination. Repacking of fish and additional processes are not required, thereby keeping labor and material costs down, and efficiency and quality up.

What Is Hypobaric Storage?

The hypobaric system consists of highly humidified air (about 95 percent relative humidity) at low pressure (1/10 atmosphere) and low temperature (0-2 °C), with controlled ventilation to minimize undesirable gases and odors (see diagram).

Unlike other controlled/modified atmosphere systems, which are relatively high in CO_2, the proportions of gases in a hypobaric environment are the same as in air. Consequently, the inferior sensory attributes and potential toxicity of fish often associated with CO_2-enriched atmospheres are eliminated.

URI Researchers Optimize the Hypobaric System

Fish storage experiments were conducted to evaluate the preservative effect of a small-scale hypobaric system and a commercial hypobaric unit[1] on fresh flounder. The small hypobaric system increased the shelf life of flounder fillets by 50 percent. When fillets were pretreated with an enzyme preservative, a glucose oxidase dip[2], hypobaric conditions extended the storage life by 90 percent.

In the commercial hypobaric unit, the shelf life of dressed flounder, boxed without ice, was extended by 50 percent relative to control fish, stored in ice. When boxed with ice, and stored in this rarefied atmosphere, dressed flounder had over a 100 percent shelf life extension.

Quality Assessment

During the storage period (an average of 28 days), the quality of fish was assessed weekly by a variety of physiochemical and sensory tests. These included surface pH; Torrymeter readings; sensory evaluation of skin, flesh, raw odor, touch, and general acceptability; and total aerobic bacteria plate counts.

Hypobaric-preserved fillets had higher Torrymeter readings and organoleptic (acceptability) scores and significantly lower surface pH and aerobic bacteria counts than ice-stored fillets (control). Objective indices were confirmed by sensory assessment, showing that fillets were effectively preserved in hypobaric storage conditions.

Surface pH and sensory assessment were reflective quality indices of the dressed flounder stored in the commercial hypobaric unit. The rate of increase in surface pH was retarded relative to the control (see Graph 1). Sensory evaluation data was used to determine quantitatively the shelf life of fish. The iced control had a shelf life of 12 days; hypobaric storage extended the quality of fish to 18 days when boxed without ice, and to 40 days when boxed with ice (see Graph 2).

"I would like to use a hypobaric system--how do I go about it?"

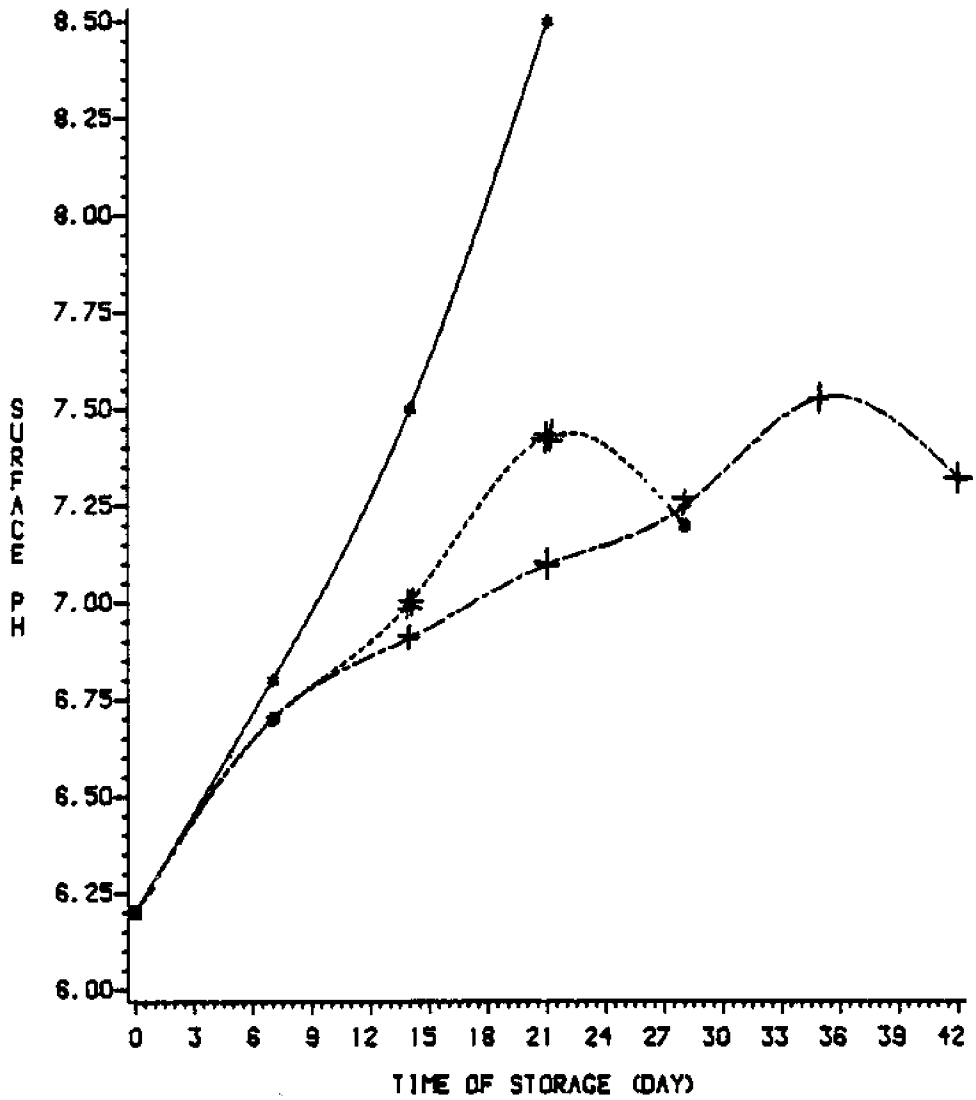
Anyone who wants to use a hypobaric system has two options. One is to purchase or lease a commercial hypobaric system, available as a 20-foot or 40-foot unit from the Transworld Corporation of Buffalo, N.Y . To optimize the preservative effect of the commercial unit, request the following report from the Department of Food Science, University of Rhode Island, Kingston, RI 02881: Hypobaric Storage of Lean and Fatty Fish, by P. Kelly,Y.H. Lin, S.M. Barnett, and A.G. Rand, Jr. (presented at the 1983 annual meeting of the Institute of Food Technologists). The second option is to develop your own hypobaric system. For information on specific procedures, contact Dr. Arthur G. Rand or Dr. Stanley J. Barnett, URI's Department of Food Science (401-792-2467).

Footnotes

[1]The commercial hypobaric unit, a 20-foot intermodal container, was provided by the Grumman-Dormavac Corportion. Present owners are Transworld Corporation, Buffalo, New York.

[2]See Fish Preservation: An Annotated Bibliography, Angel M. Hilliard and Sudip Jhaveri, URI Marine Technical Report 82, 1981. Available on loan from the National Sea Grant Depository, Pell Library, University of Rhode Island, Narragansett Bay Campus, Narragansett, RI 02882 (order RIU-L-81-001).

SURFACE PH OF FLOUNDER



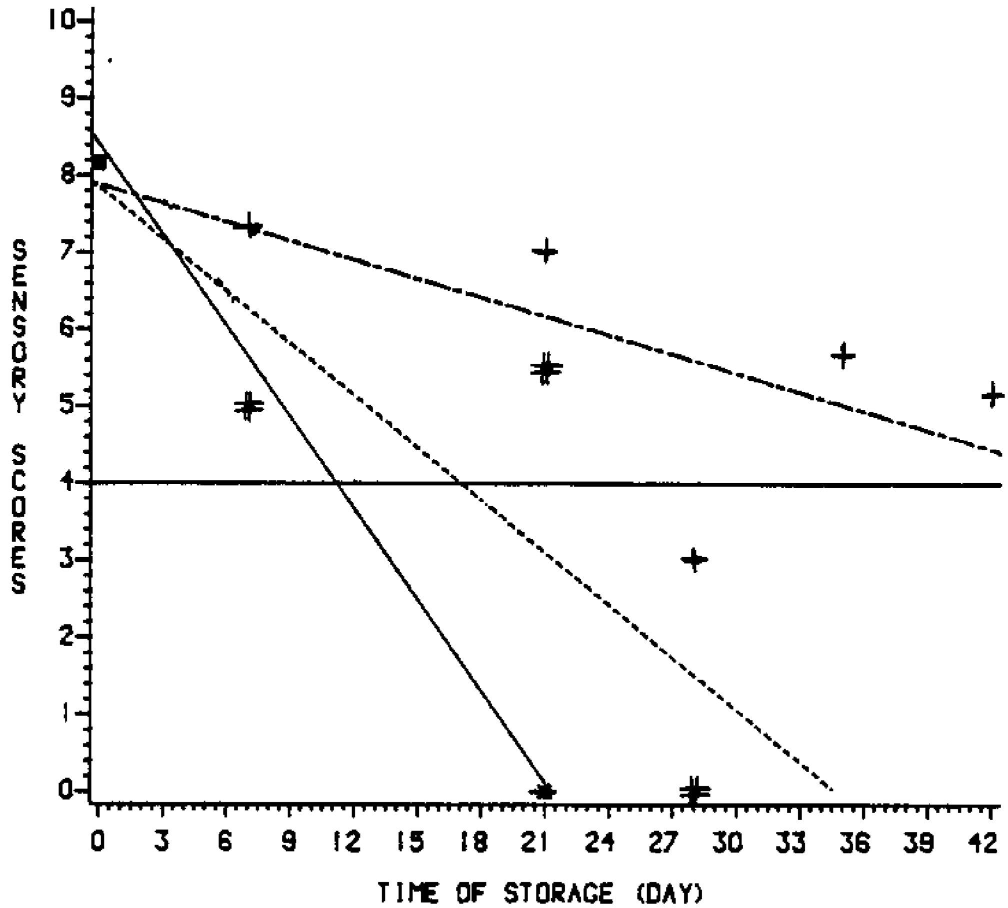
CONTROL : * , ————

HYPOBARIC : # , ------

HYPOBARIC WITH ICE : + , —-—-—

Graph 1

SENSORY SCORES OF FLOUNDER
GENERAL ACCEPTABILITY



CONTROL : * ,————

HYPOBARIC : # ,---------

HYPOBARIC WITH ICE : + ,—-——-—

LIMIT OF ACCEPTABILITY=4

Graph 2