

HANDBOOK
of
BREWING



edited by
WILLIAM A.
HARDWICK

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 of 
BREWING

edited by

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Library of Congress Cataloging-in-Publication Data

Handbook of brewing / edited by William A. Hardwick.

p. cm. — (Food science and technology ; 64)

Includes bibliographical references and index.

ISBN 0-8247-8908-3 (acid-free)

1. Brewing—Handbooks, manuals, etc. I. Hardwick, William A.

II. Series: Food science and technology (Marcel Dekker, Inc.) ; 64.

TP570.H23 1994

663'.3—dc20

94-36751

CIP

The publisher offers discounts on this book when ordered in bulk quantities. For more information, write to Special Sales/Professional Marketing at the address below.

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Marcel Dekker, Inc.

270 Madison Avenue, New York, New York 10016

Current printing (last digit):

10 9 8 7 6 5 4 3 2 1

PRINTED IN THE UNITED STATES OF AMERICA

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Preface

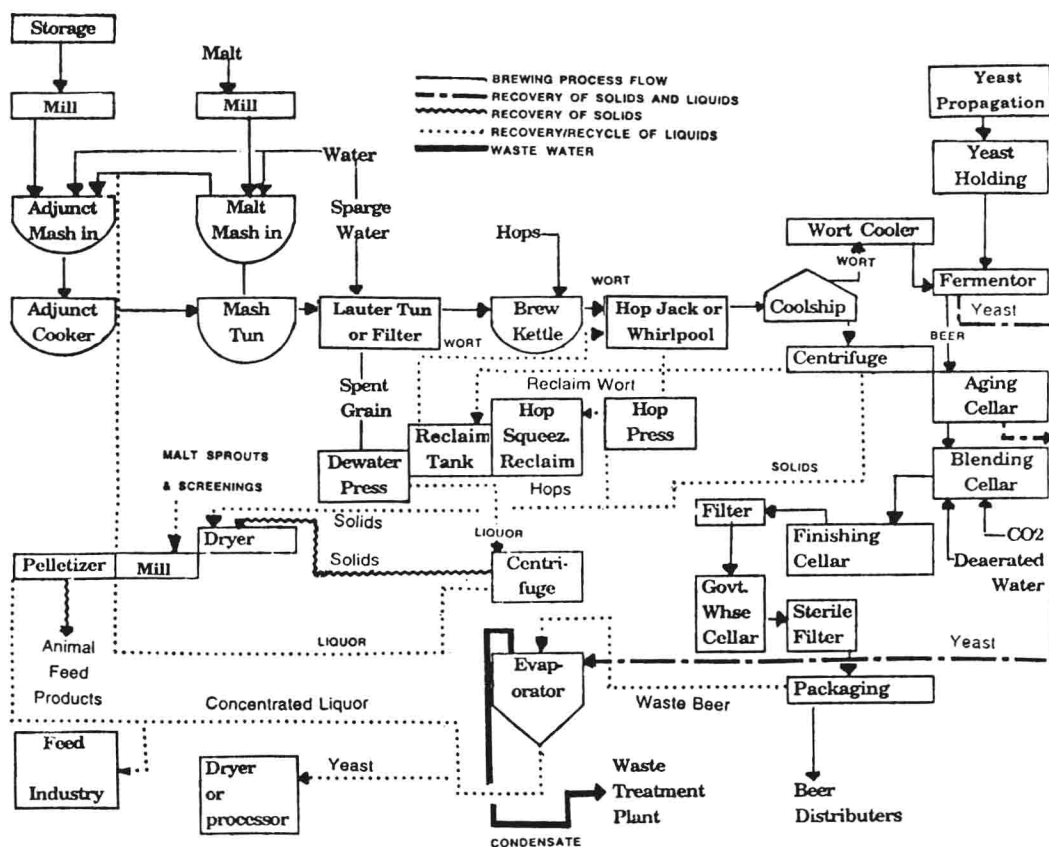
The purpose of this handbook is to provide the reader with a current, authoritative compendium on the art and science of brewing, covering essentially all beverages that are beerlike in character and alcoholic content. Brewing provides the framework for part of the book; the technology and science of brewing, which explains this art, is included in appropriate places. Each chapter is written by an author who has both academic and professional credentials.

Economic and commercial aspects are discussed in Chapter 1; breweries of the world and their products are listed here as well. The ingredients used in making beer are described in chronological order (see Chapter 6, 7, 9, and 11) and a discussion of the brewing process occupies Chapters 4 and 12–15. The small brewer will find information pertinent to microbrewing in several places. For example, Chapter 5 deals specifically with microbrewing and Chapter 20 frequently points out the various scaled-down control measures that best fit small brewing operations.

The properties of beer, both good and bad, are detailed in Chapter 19, which lists several hundred of the chemicals found in beer and explains the contributions made by many of them to general beer flavor character. Chapters 17 and 20 detail the control measures essential to the production of high-quality beer.

Each brewing topic contains both practical and detailed technical information. This rounds out the description of the various facets of the brewing process and gives the reader as much depth and detail as desired. Persons with little technical or scientific background can obtain a logically connected account of the ingredients, the process, and the product by reading the appropriate chapters. Other chapters provide those with more extensive technical or scientific backgrounds with much more detail.

A major effort has been made to describe state-of-the-art procedures and equipment employed not only in the brewing of beer but in its packaging as well. Completeness of detail, technical depth, and bibliographic material make this book suitable for classroom or other training purposes without abridging its overall usefulness as a reference work.



The brewing process.

The international scope of this book provides much worldwide technical and scientific detail, as well as economic and historical information. It does not treat classical brewing and beer alone in this respect; for example, Chapter 3 discusses other brewed alcoholic beverages of the world, many of which have long accompanied man on his journey through history.

Products and practices from all parts of the world are covered. Brewing procedures and equipment are discussed in appropriate places in the text, with the lager process general serving as the major frame of reference. Several chapters (3, 5, and 11-14) discuss the brewing practices, equipment, and ingredients used worldwide and the similarities that exist become apparent. Indeed, world brewing practices and equipment are very similar today as the international brewing community shares technology more than ever before, made easier because the brewing equipment made by major manufacturers is sold worldwide. An excellent illustration of this is seen in Chapter 12. Chapter 11 discusses the various brewing aids that are used to improve the brewing process over much of the world; only a few used exclusively in a given area. Chapter 21 will interest the serious small brewer with its brewing calculations and thorough coverage of how to use and how to systemize many of them for fast and accurate resolution right on station in the brewhouse.

It is suggested that the composite schematic diagram shown here be used as a reference while reading those chapters that discuss the brewing process. Not all breweries follow the processing steps precisely as shown, but they all will have synonymous steps.

I thank R. MacBrighton, publisher of *Modern Brewery Age* and *Modern Brewery Age Blue Book*, and Philip C. Katz, senior Vice President-Research of the Beer Institute (Washington, D.C.), who have permitted us to reproduce various copyrighted materials (specific acknowledgments are given in the legends).

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1

Commercial and Economic Aspects

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I. INTRODUCTION

A. The Probable Birth of Commercial Brewing

About 10,000 years ago, early man stopped following wild animal herds and settled into a communal existence based primarily on the planting and cultivation of crops (see Chapter 2). Since he had been gathering grains for some millennia, he probably already had a recipe for making beer. As greater yields of grain rewarded his agricultural efforts, it would make sense that he enlarged his brewing operation so some of his brewed product could be used for barter.

B. Earliest Government Control

When history found early man in the Tigris, Euphrates, and Nile flood plains, he was already producing beer and selling it at home and abroad. As one might suspect, the early rulers of these civilizations had established taxes and rules for selling beer to the consuming public. Most notable of these was Hammurabi, ruler of Babylon, who had a great number of his laws chiseled into a large boulder and placed in a public place. Among these laws were rules for operating a beer parlor, including the punishment to be meted out in cases of transgression. These rules stood for over 1000 years and were adopted by neighboring people as well.

Drunkenness was discouraged by rulers in many early civilizations. In ancient China, the rulers of several dynasties severely punished drunken behavior (Hardwick, 1983).

C. Early Taxation

In the New World, thousands of years later, a permit was issued from Spain by Don Antonio de Mendoza to Don Alfonso de Herrera of Mexico, to construct a brewery. The same

*Retired.

ship that delivered this permit in 1544 A.D. also carried one Don Hernando de Pabio, the king's tax collector; his assignment was to collect one-third of the profits from Herrera's brewery (Hardwick, 1977). As nations developed, one common practice runs through them all; the extraction of taxes from the production and sale of beer and other alcoholic beverages.

This chapter describes various government regulations as well as several economic and commercial features of the brewing industry. Wherever practicable, the brewing information given will have worldwide application; in instances, where variations exist, information pertaining to the United States will be given. Whenever this is done, an effort will be made to point out any significant differences that exist elsewhere in the world.

II. DEVELOPMENT OF THE U.S. BREWING INDUSTRY

Earliest brewing in the United States and Canada was ale brewing, done as it had been for centuries at home in the British Isles. In the nineteenth century, immigrants began to arrive from Germanic Europe bringing with them skill at lager brewing and appetites for lager beer. These beers were successful; they were broadly accepted in the New World and breweries producing lager beer sprang up across the United States followed closely by Canada and Mexico.

The development of mechanical refrigeration helped this growth because it allowed brewing to be done all year, not just in the cool months. Lower temperatures aided fermentation and the aging of lager, and retarded spoilage during the warmer months.

Pasteurization was adopted by brewers in the second half of the nineteenth century. This made it possible to market beer in bottles that could be taken home, stored, and consumed there rather than at a brewery or tavern. Shipping beer in refrigerated rail cars allowed the brewer to ship beer greater distances, increasing both his marketing volume and area. This permitted the expansion of an existing brewery rather than the building of an entirely new facility. Breweries began to grow in size and increase in number. In the late nineteenth century, almost 1300 breweries were producing more than one million barrels of beer per year.

A. Effects of Prohibition and Repeal on the Brewing Industry

Early in the twentieth century, prohibition dealt a terrible blow to brewing. In 1919, 36 states ratified the Eighteenth Amendment enacting the national prohibition of alcoholic beverages. The more enterprising brewers changed products; many began to produce ice cream or soft drinks. Several were successful; for example, the ice cream operation set up by the Stroh Brewery still operates in Detroit. Some brewers produced a malt syrup that was sold for home brewing; others, like Anheuser-Busch, brewed beer, distilled off the alcohol, and sold the dealcoholized beer. Consumers would buy this beer and add their own "bathtub gin" to it. The alcohol was sold to the food, pharmaceutical, and chemical industries. Prohibition lasted until 1933 when the Eighteenth Amendment was repealed. Breweries were reopened with surprising rapidity. Thirty-one breweries were operated by mid-year and one year later 756 were active.

In Europe, there was no prohibition, and the production of ales in the United Kingdom and Belgium continued to flourish as did the production of lager in central and northern Europe. Companies in Canada and Mexico continued brewing through the prohibition years and at the U.S. borders. Smuggling was active. Once the beer and alcoholic beverage

ages crossed the border, clandestine “bootlegging” and “speakeasies” completed the supply lines to consumers.

B. Postprohibition Growth of Brewing

From the end of prohibition until the late 1980s there was an increase in beer consumption caused by two factors: there was more than a doubling in per capita consumption and there was a tremendous increase in the numbers of citizens of beer-drinking age. This population increase leveled off in the 1980s and beer sales followed suit.

1. Reduction in the Number of Brewing Companies and Plants

Since World War II there has been a decline in the number of brewing facilities and of brewing companies in the United States. Table 1 shows the number of brewing companies and brewing plants that were active for representative years between 1935 and 1989 (*Brewers Almanac*, 1990).

The brewing companies, which had increased in number to 750 by 1935, dropped to 26 by 1989, these companies operated 65 separate brewing plants (*Modern Brewery Age Blue Book* 1989, 1990). This all took place with no decline in beer sales. Table 2 gives the yearly volume of beer sold in representative years between 1933 and 1990 and the per capita consumption for those years (*Brewers Almanac*, 1991).

Table 2 shows the significant growth of the brewing industry through the 1980s. It also shows that per capita consumption of beer increased during this period. During these years the population of the United States increased from over 126 million people in 1935 to over 248 million in 1989 (*Brewers Almanac*, 1991).

The significant increase in beer production by fewer brewing facilities is due to tremendous increases in the size of the plants constructed in recent years. A single modern brewery, either built from the ground up or modernized and expanded, has a capacity equal to over one dozen of the typical older breweries prior to the Second World War. Two brewing companies in the United States have single brewing facilities with huge annual capacities;—the Coors plant in Colorado produces over 19 million barrels of fully lagered beer annually and Anheuser-Busch, which brews about 13 million barrels per year in its St. Louis plant.

Table 1 Number of Brewing Companies, Plants, Beer Volumes Sold, Federal Taxes, and Per Capita Consumption, for the Years Shown^a

Year	Number of brewing companies	Number of brewing plants	Number of 31 gal barrels sold	Federal taxes paid (\$)	Per capita consumption U.S. gal/yr
1936	750	750	45,228,605	215,563,879	10.3
1947	404	465	87,856,902	665,081,496	17.9
1958	211	252	89,010,812	762,660,000	15.1
1967	124	170	116,564,350	945,015,000	16.8
1975	57	120	157,870,017	1,308,583,000	21.1
1982	35	87	193,984,371	1,606,303,000	23.6
1989	26	215	197,480,115	1,678,070,000	22.4

^a Due to tax increases on malt beverages, estimated federal taxes for 1992 are \$3,600,000,000.

Source: *Brewers Almanac* (1991).