

BREWING WITH HEMP

THE ESSENTIAL GUIDE



BY ROSS KOENIGS

BREWING WITH HEMP

THE ESSENTIAL GUIDE

BY ROSS KOENIGS



**BREWERS
PUBLICATIONS®**

Brewers Publications®
A Division of the Brewers Association
PO Box 1679, Boulder, Colorado 80306-1679
BrewersAssociation.org
BrewersPublications.com

© Copyright 2022 by Brewers Association

All rights reserved. No portion of this book may be reproduced in any form without written permission of the publisher. Neither the authors, editors, nor the publisher assume any responsibility for the use or misuse of information contained in this book.

Proudly Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

ISBN-13: 978-1-938469-77-0

ISBN-10: 1-938469-77-1

EISBN: 978-1-938469-78-7

Library of Congress Control Number: 2022937388

Publisher: Kristi Switzer

Technical Editor: Luke Chadwick

Copyediting: Iain Cox

Indexing: Doug Easton

Art Direction, Cover and Interior Design: Jason Smith

Production: Justin Petersen

Chapter Page Illustrations: Cory Campbell

*To the many people in my life who've inspired me
to push toward what's next. You know who you are.*

TABLE OF CONTENTS

Note from the Publisher	xi
Acknowledgments	xv
Introduction	1
What You Should Expect Out of This Book	4
So Why a Book on Cannabis and Beer?.....	6
1. A Brief History of Cannabis	11
Early Evolution of Cannabis	12
Ancient Cultivation and Use of Fiber.....	15
Origins of Domestic Fiber Usage in China and East Asia.....	18
Development and Proliferation of Paper	19
Use of Hemp Fiber for Technology and Warfare	19
Hemp Fiber and Its Role in Global Exploration, Fishing, and Maritime Applications	20
Historical Uses of Hempseed	24
History of Psychoactive Uses of Cannabis.....	26
History of Marijuana Beverages.....	30
Historical Uses of Cannabis as Medicine	34

2. Cannabis Law and Legal History	39
Middle Ages to the Turn of the Twentieth Century	40
History of Cannabis Prohibition in the US	45
Current Cannabis Law in the US	53
An Overview of Current Marijuana Laws.....	53
Agencies that Regulate Marijuana	55
An Overview of Current Hemp Laws.....	56
Labeling Practices for Hemp Beer	60
3. Cannabis Biology, Growth, and Sustainability	63
<i>Cannabis sativa</i> Ecology and Taxonomy	63
Cannabis Growth and Anatomy.....	66
Cannabis Life Cycle.....	67
Male Flowers of the Cannabis Plant.....	68
Female Flowers of the Cannabis Plant	70
Methods of Cannabis Production.....	74
Sinsemilla Production	74
Seed Production	75
Production from Feminized Seeds	76
Sustainability	78
4. Uses of the Cannabis Plant.....	87
Essential Oils	88
Applications of Essential Oils	90
Insecticides	90
Organoleptics	91
Cannabinoids	91
Products Derived from Parts of the Cannabis Plant.....	93
Inflorescences and Trichomes.....	93
Seeds.....	93
Fiber.....	95
Construction Materials from Hemp Fiber.....	99
Other Products from Hemp Fiber.....	103
Roots	104
Phytoremediation and Absorbency	105
5. Biochemistry of Cannabinoids	109
What are Cannabinoids?	110

Role of Cannabinoids in the Plant	111
Cannabinoid Biosynthesis	112
Non-Enzymatic Synthesis of Different Cannabinoids.....	114
Cannabinoid Biosynthesis from Genetically Modified Organisms	117
Overview of Cannabinoid Groups	117
Cannabigerol (CBG)	117
Delta-9 Tetrahydrocannabinol (THC)	118
Cannabidiol (CBD)	119
Cannabichromene (CBC).....	121
Cannabinol (CBN)	121
Delta-8 Tetrahydrocannabinol (Δ^8 -THC).....	121
Cannabielsoin (CBE)	122
Cannabinodiol (CBND).....	122
Cannabicyclol (CBL).....	122
Cannabitriol (CBT)	123
6. Solubilizing Shelf-Stable Cannabinoids in Beverages.....	125
 Formulating a Cannabinoid-Infused Beverage	128
Step 1: Biomass Preparation	128
Step 2: Solvent Extraction	129
Step 3: Winterization of the Extract.....	130
Step 4: Preparation of Extract and Emulsification.....	131
Step 5: Homogenization of the Emulsion.....	135
Step 6: Dosing into the Final Beverage	137
 Factors Driving Instability from Purchased Concentrates	138
 Bioavailability and Pharmacokinetics	141
7. Strategies for Dosing Cannabinoids in Beer	145
 Dosing for CBD Using Hemp Inflorescences	147
 Batch Dosing CBD	148
 In-Line Dosing of CBD	152
 Point of Dispense Dosing at Home	153
Making a Tincture: Getting Started	153
Making a Tincture: Step by Step	154
Calculating the Cannabinoid Content of Your Tincture	155
Flavoring Your Tincture.....	158
 Recipes for Tinctures.....	159
Barrel-Aged Stout Tincture	159

IPA Tincture.....	160
Low-ABV Cocktail Tincture	161
8. Biochemistry of Cannabis Oil.....	163
Overview of Terpene Biosynthesis	165
Terpene Production During Growth, Harvest, and Drying	166
How to Measure Terpenes.....	168
Demystifying the “Entourage Effect”	169
Cannabis Aroma Compounds: A Lexicon	171
9. Brewing with Cannabis: Using Hemp in the Grain Bill	177
Hempseed as a Cereal Adjunct	177
Preparing Hempseed for Mashing	179
Storing Hempseed.....	180
Recipes Using Hemp	181
Hemp Harvest German Märzen	181
Super Spice Rustic Saison.....	183
Fortification: Hempseed Abbey Ale	185
Hempseed Oil and Yeast Health and Viability.....	186
10. Brewing with Cannabis: Hemp as a Flavor.....	191
Hemp Aroma Products Available.....	194
Whole Inflorescence (“Flower”)	194
Pelletized Flower.....	194
Steam-Distilled Essential Oil.....	194
Extracts.....	195
Constructed Flavors.....	195
Adding Hemp Aroma Products in the Brewing Process	196
Wort Boil	196
Whirlpool: Aroma Addition	197
Mid-fermentation Dry Hemp.....	200
Post-fermentation Dry Hemp.....	205
Recipes with Hemp Aromas	209
New England Juice Bomb.....	209
Feelin’ Danke West Coast IPA	211
This Pilsner Came to Party	213
The Herb Pantagruelion: Hemp Gruit.....	214

11. Quality Assurance and Legal Compliance (United States)	217
General Cannabis Quality Considerations	217
Laboratory Testing for Hemp Quality Compliance	219
Testing for Cannabinoids and Terpenes	221
Testing for Contaminants	223
Hempseed Quality Assurance and Compliance.....	227
Hempseed Quality Considerations and Testing.....	227
Hempseed Legal Considerations	228
Hemp Aroma Quality Assurance and Compliance.....	229
Hemp Aroma Quality Considerations.....	229
Hemp Aroma Legal Considerations.....	231
CBD Compliance	233
CBD Quality Considerations	233
CBD Legal Considerations	236
Epilogue	241
Suggested Readings	251
Cannabis History.....	251
Racial and Criminal Justice.....	252
Technical Cannabis Publications	253
Appendix A - Hemp Farm Visit Checklist	255
Bibliography	259
Index.....	279