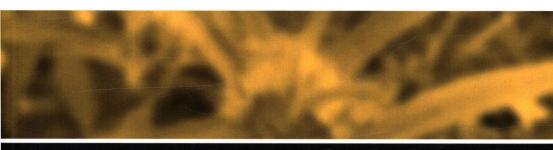
UNCONVENTIONAL OILSEEDS AND OIL SOURCES



Edited by
Abdalbasit Adam Mariod
Mohamed Elwathig Saeed Mirghani
Ismail Hussein

UNCONVENTIONAL OILSEEDS AND OIL SOURCES

Edited by

Abdalbasit Adam Mariod, Mohamed Elwathig Saeed Mirghani, and Ismail Hussein

This is the definitive guide on unconventional oilseeds and new oil sources, bringing information on oil sources for food and nonfood uses found in plants, trees, and insects. The book brings in detail the oil source general information, the physicochemical properties of the seed oil, besides the mineral compositions and the chemical analysis. It also explores the chemistry of new oils, their composition, bioactive compounds (such as fatty acids, tocopherols, and sterols) as well as their oxidative stability.

Unconventional Oilseeds and Oil Sources is presented in three parts, each one dedicated to different types of oil sources. Part A deals with plants (vegetable, herbs, shrubs), such as hibiscus, Mexican poppy, cucumber, squashes, sesame, etc. Part B presents unconventional oils found in trees (such as Balanites aegyptiaca, Annona squamosa, and Catunaregam nilotica) and Part C deals with new oils found in insects, like in the watermelon bug and sorghum bug.

This book should be of interest to researchers in oilseed production, research and development personnel, food scientists, plant breeders, product development personnel, and government agency personnel involved in the production, transportation, distribution, and processing of oilseeds.

End User Key Features

- Compiles information on unconventional oilseeds and new sources of oil found worldwide, including those from plants (vegetables, herbs, shrubs), trees, and insects.
- Presents the physicochemical properties of the seed oil, in addition to the mineral compositions and the chemical analysis.
- Explores thoroughly the chemistry of new oils, their composition, bioactive compounds (such as fatty acids, tocopherols, and sterols) as well as their oxidative stability.
- Introduces the composition of the new oil sources, their content of minor and bioactive components, and the most used official methods for analysis.







S T 5

ACADEMIC

PRESS

Unconventional Oilseeds and Oil Sources

Abdalbasit Adam Mariod Mohamed Elwathig Saeed Mirghani Ismail Hussein





Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1800, San Diego, CA 92101-4495, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

Copyright © 2017 Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

ISBN: 978-0-12-809435-8

For information on all Academic Press publications visit our website at https://www.elsevier.com/books-and-journals



Publisher: Nikki Levy

Acquisition Editor: Nina D. Bandeira Editorial Project Manager: Mariana L. Kuhl Production Project Manager: Susan Li

Designer: Alan Studholme

Unconventional Oilseeds and Oil Sources

÷

Contents

Part A

Principles of Oil Extraction, Processing, and Oil Composition: Unconventional Oils From Annuals, Herbs, and Vegetable		
Chrozophora brocchiana (Argessi)		
Botanical Description Geographical Distribution Medicinal Uses Seed Chemical Composition Physical Characteristics of Chrozophora brocchiana Seeds The Physicochemical Properties of the Seed Oil Fatty Acid and Tocopherols Composition of Chrozophora brocchiana Oil Mineral Composition of Chrozophora brocchiana References	3 3 3 5 5 5 6 7 8	
Argemone mexicana (Argemone Seed)		
Botanical Description Origin and Distribution Medicinal Uses Argemone Seed Proximate Analysis Fatty Acid Composition of Argemone mexicana Oil References	9 9 11 11 12	
Cassia obtusifolia (Senna or Sicklepod Seed) Plant Distribution Botanical Description Different Uses of Cassia obtusifolia Food and Feed Uses Medicinal Uses Seed and Leaves Composition Physicochemical Properties, Fatty Acids, and Tocopherols References	13 13 15 15 16 16 18	
	Inposition: Unconventional Oils From Annuals, bs, and Vegetable Chrozophora brocchiana (Argessi) Botanical Description Geographical Distribution Medicinal Uses Seed Chemical Composition Physical Characteristics of Chrozophora brocchiana Seeds The Physicochemical Properties of the Seed Oil Fatty Acid and Tocopherols Composition of Chrozophora brocchiana Oil Mineral Composition of Chrozophora brocchiana References Argemone mexicana (Argemone Seed) Botanical Description Origin and Distribution Medicinal Uses Argemone Seed Proximate Analysis Fatty Acid Composition of Argemone mexicana Oil References Cassia obtusifolia (Senna or Sicklepod Seed) Plant Distribution Botanical Description Different Uses of Cassia obtusifolia Food and Feed Uses Medicinal Uses Seed and Leaves Composition	

4.	Cassia (Senna) occidentalis L. (Coffee Senna)	
	Plant Distribution	21
	Botanical Description	21
	Medicinal Importance and Bioactive Potential	22
	Cassia occidentalis Seed Composition	23
	Seed Oil, Physicochemical Properties, Fatty Acid, and Tocopherols	23
	References	24
5.	Abutilon pannosum (Forst.) Ragged Mallow	
	Botanical Description	27
	Seed Composition	27
	Edible and Medicinal Uses	28
	References	29
6.	Ipomoea quamoclit Cypress Vine (Star Glory)	
	Botanical Description	31
	Plant Distribution	31
	Bioactive Compounds and Seed Composition	31
	Potentiality and Different Uses	32
	References	33
7.	Ipomoea indica Blue Morning Glory	
	Botanical Description and Plant Distribution	35
	Composition and Bioactive Components	35
	Oil Physicochemical Properties, Fatty Acid,	
	and Tocopherols Composition	35
	Potentiality and Different Uses	37
	References	37
8.	Sesamum alatum (Thonn) Winged-Seed Sesame	
	Distribution and Botanical Description	39
	Composition and Bioactive Components	39
	Oil Physicochemical Properties, Fatty Acids, and Minor	
	Components	40
	Potentiality and Different Uses	41
	References	42
9.	Hibiscus cannabinus L. Kenaf	
	Distribution and Botanical Description	45
	Composition and Bioactive Components	45
	Kenaf Seed Oil	46
	Potentiality and Different Uses	47
	References	50

	Conten	ts	vii
10.	Hibiscus radiatus Roselle Distribution and Botanical Description Seed Composition and Bioactive Compounds Potentiality and Different Uses Seed Processing, Oil Properties, and Stability References		53 53 54 5 <i>7</i>
11.	Hibiscus sabdariffa L. Roselle Distribution and Botanical Description Use in Food and Medicine Plant Composition and Bioactive Components Physicochemical Properties, Fatty Acids, and Minor Components of Karkade Seed Oil References		59 61 62 63 64
12.	Monechma ciliatum Black Mahlab or Mahlab Balady Botanical Description Origin and Habitats Uses and Medicinal Values Seed Composition and Bioactive Components References		67 67 67 70 72
13.	Nigella sativa L. Black Cumin Distribution and Botanical Description Seed Composition and Bioactive Components Uses and Medicinal Values References		73 73 77 79
14.	Cucurbits, Cucurbita Species As New Oil Sources Cucumis mello var. agrestis Muskmelon Distribution and Botanical Description Fruit and Seed Composition and Bioactive Components Uses and Medicinal Value References		81 81 83 84
15.	Cucumis melo var. flexuosus The Armenian Cucumber or Snake Melon Distribution and Botanical Description Fruit and Seed Composition and Bioactive Components Uses and Medicinal Value References		85 86 88

10.	Cucumis sativus Cucumber	
	Distribution and Botanical Description	89
	Food Uses and Medicinal Values	90
	Fruit and Seed Composition and Bioactive Components	91
	References	93
17.	Cucumis prophetarum Globe Cucumber	
	or Wild Cucumber	
	Distribution and Botanical Description	95
	Food Uses and Medicinal Values	95
	Fruit and Seed Composition and Bioactive Components	96
	References	97
18.	Citrullus colocynthis Colocynth, Bitter Apple,	
	Bitter Gourd	
	Distribution and Botanical Description	99
	Fruit and Seed Composition and Bioactive Components	100
	Different Uses and Medicinal Values	102
	References	103
10	Cucumic mala yar cantaluna Cantalauna	
19.	,	
	Distribution and Botanical Description	107
	Fruit, Seed Composition, and Bioactive Compounds	107
	Medicinal and Different Uses	109
	References	110
20.	Luffa echinata Bitter Luffa, Bristly Luffa	
20.	, ,	112
	Distribution and Botanical Description Different Uses and Medicinal Values	113
		113
	Fruit and Seed Composition and Bioactive Components	114
	References	115
21.	Luffa clynderica Loofah, Sponge Gourd	
21.	,	117
	Distribution and Botanical Description	117
	Different Uses and Medicinal Value	118
	Fruit and Seed Composition and Bioactive Components References	121
	References	122
22.	Trigonella foenum-graecum Fenugreek,	
22.	Bird's Foot, Greek Hayseed	
	Botanical Description and Distribution	125
	Different Uses and Medicinal Value	125
	Fruit and Seed Composition and Bioactive Components	128
	References	129

23.	Guizotia abyssinica (L.f.) Cass. Niger Botanical Description and Distribution Different Uses and Medicinal Value Fruit and Seed Composition and Bioactive Components References	131 132 133 136
Par Un	t B conventional Oils from Tree Sources	
24.	Acacia tortilis Umbrella Thorn Tree Seed Oil	
	Introduction	139
	Extraction of Oil	139
	Methyl Esterification	140
	Fatty Acid Analysis	140
	Organoleptic Characteristics and Analytic Comparison	
	with Other Oil	141
	References	142
25.	Annona squamosa L. Sugar Apple Seed Oil	
	Introduction	145
	Analytical and Test Methods	146
	Physicochemical Properties of Sugar Apple Seed Oil	146
	Fatty Acid Composition of Sugar Apple Seed Oil	148
	Transesterification Reaction	149
	Effect of Catalyst Concentration on Biodiesel Production	149
	References	150
26.	The Potential of Sodom Apple (Calotropis procera and Calotropis gigantea) Seed Oil	
	Introduction	151
	Apple of Sodom Seed Oil	152
	Potential Uses of Sodom Apple Seed Oil	152
	References	154
27.	Balanites aegyptiaca Seed Oil	
	Introduction	157
	Morphological Study of <i>Balanites aegyptiaca</i> Del.	157
	Flowering, Fruit, and Seed Description	158
	Distribution and Habitat	158
	Pharmacological Activity	158
	Antiinflammatory Activity	158
	Toxicity Study	159
	Antidiabetic Property	160
	Antimicrobial Activity	161

x Contents

	Pesticidal Effect	161
	Antioxidant Activity	161
	Anthelmintic Activity	162
	Larvicidal Activity	162
	Oil Extracted from Balanites aegyptiaca Seed Kernel	162
	Conclusion	164
	References	164
28.	Vangueria madagascariensis (Rubiaceae) as New Oil Source	
	Distribution and Botanical Description	167
	Chemical Composition and Main Constituents	168
	Medicinal and Other Uses	169
	Physicochemical Properties of Vangueria madagascariensis	
	Kernel Oil	169
	Fatty Acid Composition	170
	Tocopherols	170
	Sterol Composition	171
	Amino Acid Profile	172
	Oxidative Stability of Kirkir Oil	173
	Total Phenolic Content	174
	Identification of Phenolic Compounds Using HPLC-DAD	174
	Total Flavonoid	175
	1,1-Diphenyl-2-Picrylhydrazyl Radical Scavenging Activity ORAC Antioxidant Activity Assay	175
	Cytotoxic Activity Cytotoxic Activity	176 176
	Stability of Sunflower Oil as Affected by the Addition	170
	of Vangueria madagascariensis Extracts	177
	Stability of Sunflower Oil Measured by Conjugated	177
	Dienes as Affected by the Addition of Different Extracts	
	from Vangueria madagascariensis—VML, VMC, and VMB	178
	References	178
29.	Phoenix dactylifera Date Palm Kernel Oil	
	Introduction	181
	Date Palm Kernels	181
	About Date Pits	183
	References	185
30.	Durio zibethinus (Durian)	
	Introduction	187
	Durio zibethinus Tree	188
	The Uses of Durian Tree	190
	Oil of the Durian Tree	192
	Conclusion	195
	References	196

31.	Jatropha curcas L. Seed Oil	
	Introduction	199
	Oil Extraction	200
	Physicochemical Property of Oil	202
	Suitability for Biodiesel Production	203
	Other Uses of Jatropha Oil	205
	References	206
32.	Mesua ferrea Nahar Tree Seed Oil	
	Introduction	209
	Applications of M. ferrea	210
	As Bioactive Compounds for Medicinal Drugs	210
	Production Epoxidized Oil	210
	Polyester Resin Preparation	211
	Fuel Blends	211
	Characteristics of M. ferrea and its Oils	211
	Biological Properties	214
	Antibacterial	214
	Antiinflammatory	215
	Anticonvulsant	215
	Antioxidant	215
	Anticancer	216
	References	216
33.	Nephelium lappaceum L. Rambutan Kernel Oil	
	Introduction	219
	Constituents of the Seed	220
	Solid Fat Content of Rambutan Seed	221
	Extraction of Seed Oil	221
	Biochemical	222
	Acute Oral Toxicity	222
	Dermal Irritation Study	223
	Dermal Toxicity Study	223
	Antioxidant and Antibacterial Activities	223
	Physiochemical	224
	Suggested Usages	225
	References	225
34.	Mangifera indica Mango Seed Kernel Oil	
	Introduction	227
	Applications and Uses of Mango Kernel Oil	228
	References	231
35.	Moringa oleifera Seed Oil	
	Introduction	233
	Moringa Seed Oil	234
	0	237

xii Contents

	Total Phenolic, Flavonoid, and Antioxidant Capacity Uses of Moringa Seed Oil References	237 239 240
36.	Ziziphus spina-christi (Christ's Thorn Jujube)	
	Introduction Botanical Description and Chemical Composition	243
	of the Tree	244
	Seed Oil and Fatty Acids	245
	Uses of the Christ's Thorn Jujube Tree	245
	Christ's Thorn Jujube Tree Oil	246
	Conclusion References	248248
37.	Salvadora persica Seed and Seed Oil	
	Introduction	251
	Total Amount of Phenolic Compounds	255
	References	256
38.	Sclerocarya birrea Marula (Homeid) Seed Oil	
	Introduction	259
	Food Uses	259
	Sclerocarya birrea Seed Oil	260
	Uses of Sclerocarya birrea Seed Oil	262264
	Changes in Oxidative Stability References	264
39.	Adansonia digitata Baobab Seed Oil	
	Introduction	267
	Baobab (Adansonia digitata) Seed Oil	268
	Uses of Baobab Seed Oil	269
	References	270
40.	Sterculia setigera (Karaya Gum Tree) A New Oil Source	
	Distribution and Botanical Description	273
	Chemical Composition and Main Bioactive Components	274
	Medicinal and Other Uses	275
	Fatty Acid Composition and Physicochemical Characteristics of Tartar (Sterculia setigera) Oil	275
	References	276
41.	Albizia lebbeck (L. Benth.) Lebbeck Tree Seed	
	Botanical Description	277
	Distribution and Habitat	277
	Medicinal Uses	277

		Contents	xiii
	Albizia lebbeck Seed Composition Minor Components and Physicochemical Properties		279
	of <i>Albizia lebbeck</i> Oil		279
	Fatty Acid Composition of Albizia lebbeck Oil		280
	References		280
Par			
Une	conventional Oils from Insects		
42.	Tessaratoma papillosa Longan Stink Bug		
	Description		285
	Distribution		285
	Insect Composition and Bioactive Components		285
	Different Uses and Medicinal Value References		286 287
	References		207
43.	Copris nevinsoni Dung Beetle		
	Description		289
	Distribution		289
	Different Uses		289
	Chemical Composition		290
	References		291
44.	Schistocerca gregaria (Desert Locust) and Locust migratoria (Migratory Locust)	a	
	Introduction		293
	Description		293
	Distribution		293
	Food Uses and Other Uses		294
	Edible Locust Species		294
	Chemical Composition and Bioactive Compounds		296
	References		296
45.	Oecophylla smaragdina Fabricius Weaver Ant		
	Description and Distribution		299
	Different Uses		299
	Composition and Bioactive Compounds		301
	References		304
46.	Aspongopus viduatus Watermelon Bug As Source of Edible Protein and Oil		
	Distribution and Description		305
	Different Uses and Medicinal Value		306
	Insect Composition and Bioactive Components		309
	References		312

4/.	as a Source of Edible Protein and Oil	
	Distribution and Description	315
	Different Uses and Medicinal Value	316
	Insect Composition and Bioactive Components	318
	References	320
48.	Acheta domesticus House Cricket	
	Description	323
	Distribution	323
	Composition	323
	Food uses and Different Uses	324
	References	325
49.	Alphitobius diaperinus the Lesser Mealworm and the Litter Beetle	
	Description	327
	Distribution	327
	Chemical Composition and Bioactive Compounds	328
	Uses	329
	References	329
50.	Tenebrio molitor Mealworm	
	Description	331
	Food Uses and Other Uses	331
	Composition and Bioactive Components	334
	References	335
51.	Blaptica dubia Cockroaches	
	Description	337
	Distribution	337
	Food Uses and Other Uses	337
	Composition and Bioactive Components	339
	References	340
52.	Macrotermes bellicosus Termite	
	Description	341
	Distribution	341
	Food Uses and Different Uses	342
	Chemical Composition and Bioactive Components	344
	References	345