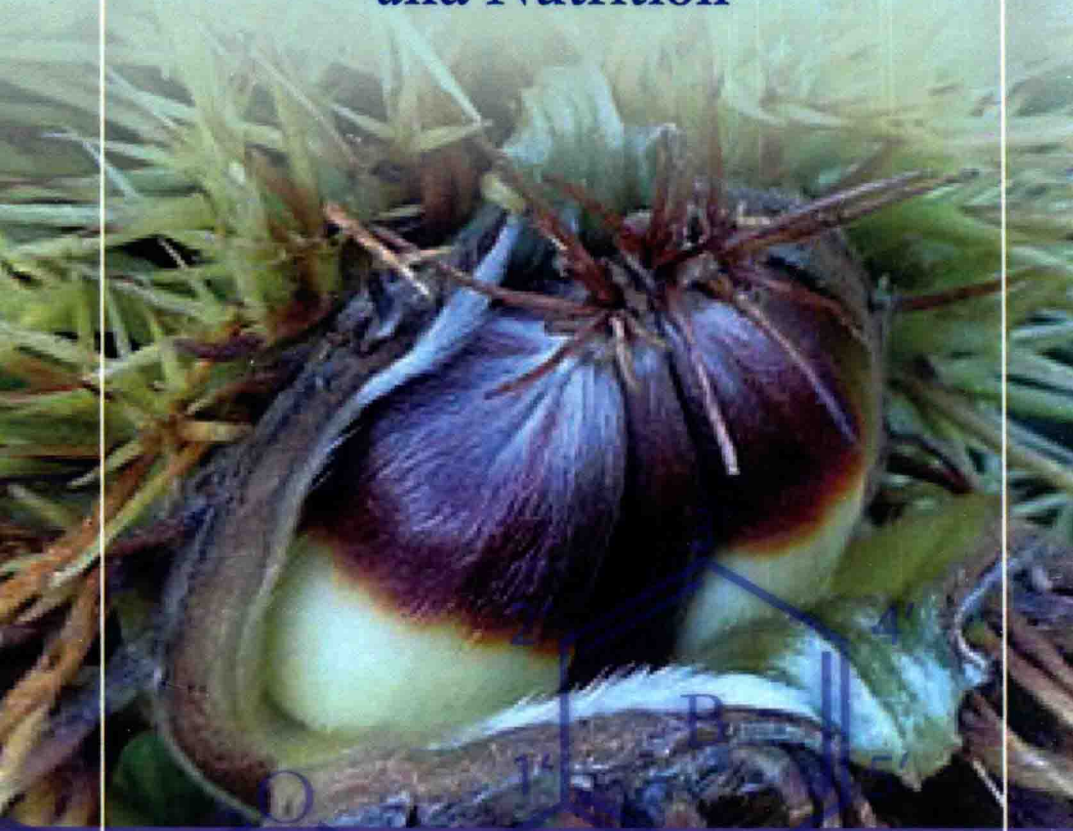
Agriculture Issues and Policies

NUTS

Properties, Consumption and Nutrition



Isabella M. Davis
Editor

NOVA

AGRICULTURE ISSUES AND POLICIES

NUTS: PROPERTIES, CONSUMPTION AND NUTRITION

ISABELLA M. DAVIS
EDITOR

Nova Science Publishers, Inc.
New York

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA

Nuts : properties, consumption and nutrition / editor: Isabella M. Davis.
p. cm.
Includes index.
ISBN 978-1-61761-978-6 (hardcover)
1. Nuts--Composition. 2. Nuts--Health aspects. I. Davis, Isabella M. II. Title.
TX399.N874 2011
634'.5--dc22

2010036148

Published by Nova Science Publishers, Inc. + New York

AGRICULTURE ISSUES AND POLICIES

NUTS: PROPERTIES, CONSUMPTION AND NUTRITION

AGRICULTURE ISSUES AND POLICIES

Additional books in this series can be found on Nova's website under the Series tab.

Additional E-books in this series can be found on Nova's website under the E-books tab.

FOOD AND BEVERAGE CONSUMPTION AND HEALTH

Additional books in this series can be found on Nova's website under the Series tab.

Additional E-books in this series can be found on Nova's website under the E-books tab.

PREFACE

Several epidemiological studies have revealed that people who consume nuts regularly are less likely to suffer from coronary heart disease. Clinical trials have found that consumption of various nuts such as almonds and walnuts can lower serum LDL cholesterol concentrations. Although nuts contain various substances thought to possess cardioprotective effects, scientists believe that their Omega 3 fatty acid profile is at least in part responsible for the hypolipidemic response observed in clinical trials. This book presents current research in the study of nut properties, consumption and nutrition.

Chapter 1 - Epidemiologic studies have been remarkably consistent in showing that frequent nut consumption is negatively associated with incidences of some chronic diseases such as cardiovascular diseases, certain types of cancers, and diabetes. Besides favorable fatty acid and other macro-, micro-nutrient profiles, nuts, including almonds, Brazil nuts, cashews, hazelnuts, macadamia nuts, pecans, pine nuts, pistachios, walnuts, and peanuts, are rich in bioactive components such as phenolics, tocopherol, and phytosterols, which are considered to be responsible for different biological effects. Specifically, nuts contain many different antioxidants. Besides vitamin A, vitamin C and β-carotene, nuts are also known to possess antioxidants such as flavonoids, isoflavones, luteolin, tocotrienols, and ellagic acid as well as plant sterols. In this chapter, bioactive compounds including phytochemical composition, biological activities, and associated health benefits in edible nuts and peanuts are extensively and critically reviewed based on a compilation of updated research.

Chapter 2 - The shea tree, *Vitellaria paradoxa,* is a tree widely distributed and usually protected in the Northern Nigeria. Both the fruit pulps and the nuts

are economically important to the rural poor. There are distinct ecological variations in the fruit and nut physicochemical attributes of Shea in Nigeria. Our studies indicated significant variation in all metric traits of fruits and nuts, except fruit length, fruit shape index and testa weight, across agro-ecological zones. All metric traits except fruit shape index also showed remarkable diversity across accessions (individual locations), with fruit length, nut length, fruit weight and nut weight ranging from 4.3-5.9 cm, 3.1-5.4 cm, 26.8-63.4 g and 8.7-22.0 g, respectively. Fruit pulp nutritional composition is significantly influenced by agroecological zone in respect of carbohydrate, protein, fibre, energy, Na, K, Mg and Fe. Fruits from the wetter southern guinea savanna zone have less fibre but higher amount of carbohydrate, energy and Na while those from the drier sudan savanna zone are richer in protein, K, Mg and Fe. The specific locations of fruit collection (accessions) have significant influence on all nutritional traits. The range in energy related proximate traits is 29.3-45.3% carbohydrate, 2.6-7.0% protein and 0.7-1.7% fat. The element Fe has significant positive statistical linkage with Zn, Mg, K and Na. All proximate traits of the shea kernel except ash content vary remarkably across ecological zones. With the exception of moisture and fibre all other proximate traits of the kernel cake are statistically similar across agroecological zones. However, all proximate traits of the shea kernel and kernel cake vary ($P < 0.05$) across sites with shea kernels from Kachia and Jalingo recording highest values for fat. Correlations between kernel and fruit pulp proximate qualities revealed a low number of significant relationships. Fatty acid profile has shown significant influence of agroecology over stearic and oleic acids content while all the four fatty acids (stearic, oleic, linoleic and palmitic acids) are significantly influenced by individual locations. The range in the stearic and oleic acids content is 45.1-49.7% and 37.2-43.4%, respectively. Generally, the fruit pulp and seed of shea have excellent nutritional properties capable of meeting the dietary needs of the rural population. Besides, both physical (metric) and nutritional traits of fruits and nuts of the shea tree have shown considerable variation across the major distribution zones in Nigeria suggesting a possibility of selection for the genetic upgrading of the species in the country.

Chapter 3 - *Anacardium occidentale* (cashew), a member of the Anacardiaceae family, is a tropical tree indigenous to Brazil. It is extensively cultivated in India and east Africa for its kernel (the cashew nut). Cashew nut shell liquid (CNSL) is a substance contained between the kernel`s inner and outer shells (pericarp) in a honeycomb matrix. It is an important agricultural product of cashew nut cultivation and a unique natural source of unsaturated

long-chain phenols. Typically, solvent-extracted CNSL contains anacardic acid (60-65%), cardol (15-20%), cardanol (10%), and traces of 2-methyl cardol. These compounds exhibit antibacterial, antifungal, and antitumor activities and also have molluscicidal, insecticidal, and fungicidal applications. They are known to be uncoupling factors of oxidative phosphorylation in the mitochondria and they show antioxidant activity and inhibitory activity against enzymes (e.g. α-glucosidase, ß-lactamase, lipoxygenase, xanthine oxidase, and tyrosinase). The classes of compounds present in CNSL are also present in other plant extracts. They have identical chemical structures and their biological activities have been very extensively examined. This review focuses on recent data on the biological activities of those bioactive compounds found in both CNSL and other plants with identical chemical structures.

Chapter 4 - The present study investigated the effect of packaging material O_2 permeability, light, temperature and storage time on quality of raw ground walnuts and almonds. Samples were packaged in a) PET//LDPE, 70 μm in thickness and b) PET-SiOx//LDPE pouches, 62 μm in thickness under nitrogen. Samples were stored either under fluorescent light or in the dark at 4 or 20 °C for a period of 12 months. Quality parameters monitored were peroxide value (PV), hexanal, and the sensory attributes: odor and taste of product.

PV ranged between 0.3 meq O_2 /kg oil for fresh ground walnuts and 30.0 meq O_2/kg oil for samples packaged in PET//LDPE pouches under N_2, exposed to light at 20 °C after 12 months of storage. Respective values for ground almonds were 0.3 and 20.0 meq O_2/kg oil. Hexanal ranged under 28.5μg/kg (method detection limit) for fresh ground walnuts and 34.0 mg/kg for samples packaged in PET//LDPE exposed to light at 20 °C after 12 months of storage. Respective values for ground almonds were < 28.5 μg/kg and 9.0 mg/kg. Values for odor ranged between 8.6 (scale 9-1) for fresh walnut kernels and 1.4 for walnut kernels packaged in PET//LDPE exposed to light after 12 months of storage at 20 °C. Respective values for taste were 7.8 and 1.3. Odor values for ground almonds ranged between 8.9 for fresh products and 4 for products packaged in PET//LDPE exposed to light after 12 months of storage. Respective values for taste were 8.9 and 2.2. Taste proved to be a more sensitive attribute than odor. Based mainly on sensory analysis, ground walnuts retained acceptable quality for ca. 6 months in PET//LDPE-N_2 and at least 12 months in PET-SiOx//LDPE-N_2 pouches at 20 °C, with samples stored in the dark retaining higher quality than those exposed to light. Respective shelf lives at 4 °C were 6-7 and at least 12 months. Shelf life of ground almonds were ca. 6-7 months packaged in PET//LDPE and 8 months packaged

in PET-SiOx//LDPE pouches under N_2 irrespective of lighting conditions at 20 °C while at 4 °C shelf life was extended by an additional month as compared to storage at 20 °C. PET-SiOx//LDPE proved to be an effective oxygen barrier for the protection of ground walnut and almonds sensory quality.

Chapter 5 - *Vitellaria paradoxa* Gaertn or the shea tree produces kernels which have a fat content of about 35-60% usually referred to as shea butter. This butter is used traditionally in foods and medicines while on an industrial scale it used in the cosmetics and chocolate industries. The processing of fruits to obtain butter involves collection of the fruits, depulping to give nuts, cooking of the nuts, dehusking to give the kernels, drying of kernels and oil extraction. The cooking and drying of sheanuts are critical steps in the traditional processing of shea kernels which largely determine butter quality. This work presents results on the physical properties of shea fruits and nuts which affect these critical steps and consequently butter quality. Shea fruits from 7 localities (Gashiga, Rabingha, Hina, Tchabal, Deone, Foumban and Banguoa) which cut across four ecological zones of Cameroon were harvested and their physical properties determined. The major diameters of the fruits and nuts ranged from 43.8 ± 6.3 to 69.62 ± 10.57 mm and 32.80 ± 2.91 to 44.29 ± 5.09 mm respectively. The sizes of the shea fruits and nuts analysed were highly dependent on the altitude of the sampling site. The sphericities of the fruits and nuts lay between 0.7 and 1 indicating that they essentially spherical in shape. Larger fruits were found at altitudes greater than 1200 m while smaller fruits and nuts grew generally at altitudes ranging from 200-600 m. More than 77 % of the nuts from all the sampling sites had major diameters ranging from 40-45 mm. significant differences were equally observed in the physical properties of the fruits and nuts obtained from different trees within and between sampling sites. An empirical relation was established and validated for inter-converting between the major diameter of the fruits and nuts. This relation can be used to estimate major diameters of the fruits from the nuts given that most often only the nut is available due to the highly perishable nature of the fruit pulp. Sheanut kernels are large (34-45 mm in diameter) and therefore have to be dried as thin slices in order to fasten drying times. Results on some physical properties of the kernels are also reported.

Chapter 6 - The application of anaerobically digested biosolids as a nutrient source for the pecan *Carya illinoinensis* (Wangeh.) K. Koch, cultivar Western, during three years was evaluated. The bearing shoot grew 16% more and nut production per tree was 11.3% higher in the biosolid treatment, on a three-year average. The accumulation of As, Cd, Cr, Hg, Ni and Pb in soil due to biosolids was very low and according to the U.S. standard, the maximum

allowable concentration would be reached in 34 years. Quantities of Cd, Cr, Ni and Pb in the kernel were below detection limits. As and Hg were found in very small quantities, and were below the limits allowed for nuts in the United Kingdom. During the preharvest, in soil fertilized with biosolids and in nuts which had contact with biosolids, the presence of *Escherichia coli* and *Salmonella* sp. were not detected.

Chapter 7 - Areca nut (AN, *Areca catechu* L.) is a popular but carcinogenic chewing material used by approximately 200–600 million people worldwide. In the past few decades, AN has been discovered to possess genotoxic, cytostatic, and cytotoxic effects on cells. Some ingredients of AN, such as AN extract (ANE), arecoline, hydroxychavicol, and oligomeric procyanidins were demonstrated to stimulate apoptotic and/or growth arresting phenotypes in treated cells. However, our recent studies showed that ANE predominantly induces the autophagic responses, albeit the simultaneous initiation of apoptotic pathway. This finding may renew the knowledge about the cytotoxic effects of AN on oral cells in physiological conditions.

CONTENTS

In: Nuts: Properties, Consumption... ISBN 978-1-61761-978-6
Editor: Isabella M. Davis

Chapter 1

BIOACTIVE COMPONENTS IN EDIBLE NUTS AND HEALTH BENEFITS

Jun Yang[1], Jiaren Liu[2] and Dana L. Felice[3]
[1]Frito-Lay North America RandD, 7701 Legacy Drive, Plano, TX, 75024
[2]Department of Anesthesia, Harvard Medical School,
300 Longwood Ave, Boston, MA, 02115
[3]Department of Physiology and Biophysics, University of Illinois at Chicago, 835 S. Wolcott Ave., Chicago, IL 60612

ABSTRACT

Epidemiologic studies have been remarkably consistent in showing that frequent nut consumption is negatively associated with incidences of some chronic diseases such as cardiovascular diseases, certain types of cancers, and diabetes. Besides favorable fatty acid and other macro-, micro-nutrient profiles, nuts, including almonds, Brazil nuts, cashews, hazelnuts, macadamia nuts, pecans, pine nuts, pistachios, walnuts, and peanuts, are rich in bioactive components such as phenolics, tocopherol, and phytosterols, which are considered to be responsible for different biological effects. Specifically, nuts contain many different antioxidants. Besides vitamin A, vitamin C and β-carotene, nuts are also

1 Corresponding author: Email: junyang97@gmail.com.
2 Email: jiarenliu@yahoo.com
3 Email: DLF34@uic.edu.

known to possess antioxidants such as flavonoids, isoflavones, luteolin, tocotrienols, and ellagic acid as well as plant sterols. In this chapter, bioactive compounds including phytochemical composition, biological activities, and associated health benefits in edible nuts and peanuts are extensively and critically reviewed based on a compilation of updated research.

INTRODUCTION

Nut consumption is inversely associated with incidences of some chronic diseases such as cardiovascular diseases, certain types of cancers, and diabetes. In July 2003 the U.S. Food and Drug Administration (FDA) approved a new qualified health claim for nuts and heart disease - "Scientific evidence suggests but does not prove that eating 1.5 ounces (42 grams) per day of most nuts as part of a diet low in saturated fat and cholesterol may reduce the risk of heart disease." Tree nuts are cholesterol-free and full of nutrients, including fat, protein and fiber. Nuts are also a great source of vitamins such as folic acid, niacin and vitamins E and B_6, and minerals like magnesium, copper, zinc, selenium, phosphorus and potassium. Some nuts are good sources of antioxidants such as vitamin E, selenium, and certain phytochemicals. Tree nuts and peanuts are rich in a number of bioactive components with health-promoting benefits. The common bioactive components, including phytochemicals such as carotenoids, phenolics, and alkaloids, present in tree nuts and peanuts are listed in Figure 1. As consumers become increasingly aware of healthy diets, the bioactive component profile of edible nuts would help them make informed decisions on selecting and consuming these nutritious foods.

NUT BIOACTIVE COMPONENTS

Commonly, the most popular and commercially important edible nuts are almonds (*Prunus dulcis*), cashews (*Anacardium occidentale*), Brazil nuts (*Bertholetia excelssa*), hazelnuts (*Corylus avellana*), macadamias (*Macadamia integrifolia*), pecans (*Carya illinoinensis*), pine nuts (*Pinus pinea*), pistachios (*Pistachia vera*), walnuts (*Juglans regia*), and peanuts (*Arachis hypogaea*). Phytochemicals, broadly classified as alkaloids, nitrogen-containing

compounds, carotenoids, organosulfur compounds, phenolics, and phytosterols, are defined as bioactive non-nutrient components in plant foods.

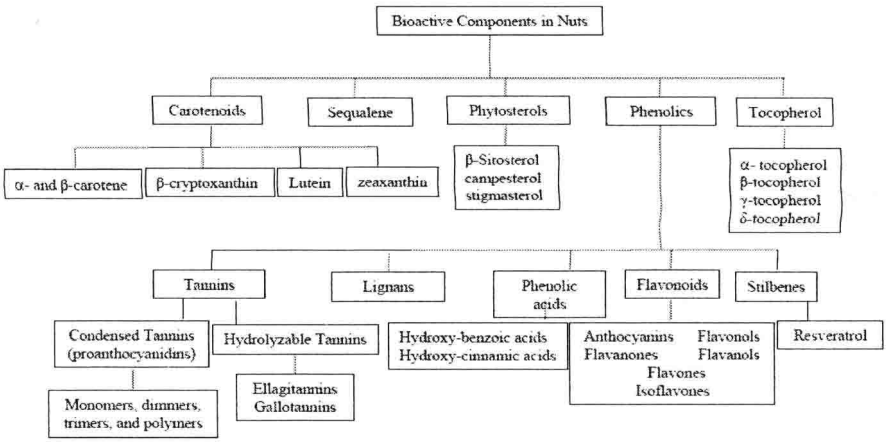


Figure 1. Bioactive components in tree nuts and peanuts.

Nuts contain bioactive constituents such as phenolics, carotenoids, phytosterols, tocopherols and squalene, which have been found to possess biological effects against cardiovascular disease, cancers, and other types of chronic diseases.

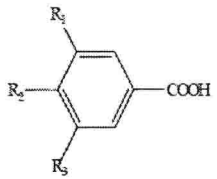
1. Phenolics

Phenolics constitute one of the largest and most ubiquitous groups of phytochemicals. They can be grouped into more than ten subtypes based on their chemical structure (Strack, 1997). Phenolics share a common chemical structure and differ in their linkages to other compounds. All phenolics possess an aromatic ring bearing one or more hydroxyl groups (Figure 2, 3, and 4). The majority of phenolics have a sugar residue, such as a monosaccharide, disaccharide, or oligosaccharide, linked to the carbon skeleton. Other residues include amines, organic acids, carboxylic acids, and lipids. The thousands of identified phenolic structures greatly vary from simple compounds such as phenolic acids with a C6 ring structure to highly polymerized molecules such as tannins.

Total phenolics have been quantified in tree nuts and peanuts. The profiles of total phenolics and flavonoids, including both soluble free and bound forms,

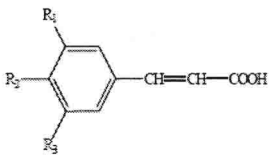
were investigated by utilizing solvent extraction, base digestion, and solid-phase extraction methods (Yang et al., 2009a).

1) Benzoic Acid



Benzoic acid Derivatives	Substitutions		
	R_1	R_2	R_3
p-Hydroxybenzoic acid	H	OH	H
Protocatechuic acid	H	OH	OH
Vanillic acid	OCH_3	OH	H
Syringic acid	OCH_3	OH	OCH_3
Gallic acid	OH	OH	OH

2) Cinnamic Acid



Cinnamic acid Derivatives	Substitutions		
	R_1	R_2	R_3
p-Coumaric acid	H	OH	H
Caffeic acid	OH	OH	H
Ferulic acid	OCH_3	OH	H
Sinapic acid	OCH_3	OH	OCH_3

3) Resveratrol

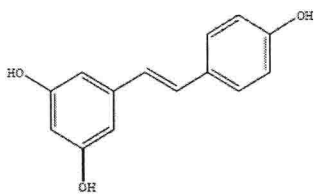


Figure 2. Chemical structures of common phenolics in tree nuts and peanuts.

Walnuts contained the richest total phenolic and flavonoid contents (1580.5 ± 58.0 mg/100 g, 744.8 ± 93.3 mg/100 g in dry nuts, respectively). The amount of total phenolics in 10 different types of nuts was analyzed (Kornsteiner et al., 2006). The average content of total phenolics ranged from 32 mg in pine nuts to 1625 mg gallic acid equivalents/100 g in fresh walnuts (Table 1).

Phenolic acids in almond, pine nut, and black walnut were extracted by methanol-HCl and analyzed as their methyl esters/trimethylsilyl derivatives by GLC-MS (Senter et al., 1983).

Table 1. Total phenolic and flavonoid contents of 9 tree nuts and peanuts (Kornsteiner et al., 2006; Yang et al., 2009)

Edible Nut Seeds	Phenolics (mg/100g dry weight)			Total Phenolics (mg/100g fresh weight)	Flavonoids (mg/100g dry weight)		
	Free Form	Bound Form	Total	Range	Free Form	Bound Form	Total
Almonds	83.0 ± 1.3	129.9 ± 13	212.9 ± 12.3	130 - 456	39.8 ± 2.0	53.7 ± 11.9	93.5 ± 10.8
Brazil Nuts	46.2 ± 5.7	123.1 ± 18.4	169.2 ± 14.6	100 - 133	29.2 ± 7.2	78.6 ± 9.2	107.8 ± 6.0
Cashews	86.7 ± 8.1	229.7 ± 15.1	316.4 ± 7.0	131 - 142	42.1 ± 3.8	21.6 ± 5.2	63.7 ± 2.1
Hazelnuts	22.5 ± 1.1	292.2 ± 48.4	314.8 ± 47.3	101 - 433	13.9 ± 2.3	99.8 ± 28.5	113.7 ± 30.2
Macadamia Nuts	36.2 ± 2.6	461.7 ± 51.2	497.8 ± 52.6	45 - 46	9.4 ± 0.7	128.5 ± 9.3	137.9 ± 9.9
Peanuts	352.8 ± 22.2	293.1 ± 25.0	645.9 ± 47.0	326 - 552	145.5 ± 10.0	44.2 ± 5.2	189.8 ± 13.1
Pecans	1227.3 ± 8.4	236.6 ± 28.1	1463.9 ± 32.3	1022 - 1444	639.3 ± 17.0	65.4 ± 12.7	704.7 ± 29.5
Pine Nuts	39.1 ± 0.6	113.8 ± 14.3	152.9 ± 14.1	30 - 34	13.0 ± 1.5	32.0 ± 6.8	45.0 ± 5.4
Pistachios	339.6 ± 15.1	232.2 ± 13.3	571.8 ± 12.5	492 - 1442	87.4 ± 14.0	55.9 ± 13.6	143.3 ± 18.7
Walnuts	1325.1 ± 37.4	255.4 ± 25.0	1580.5 ± 58.0	1020 - 2052	535.4 ± 71.5	209.4 ± 22.1	744.8 ± 93.3