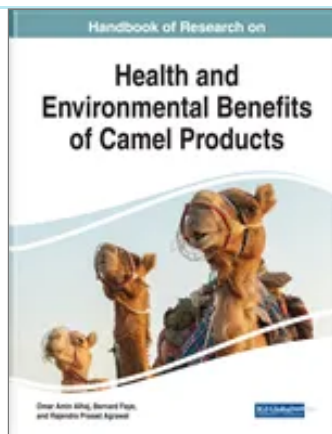


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Omar Amin Alhaj (University of Petra, Jordan), Bernard Faye (Independent Researcher, France) and Rajendra Prasad Agrawal (Independent Researcher, India)

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Description

In recent years, there has been a rise in the demand of alternative agricultural commodities, specifically camel milk-based products. Camel products have become highly coveted items in today's commercial market due to their environmental and health advantages. However, there is a lack of research and literature on camel milk and related camel goods. Up-to-date information is needed to give researchers a better understanding of the compositional and functional properties of camel milk production.

The **Handbook of Research on Health and Environmental Benefits of Camel Products** is an essential reference source that discusses the nutritional, physical, and chemical factors of camel milk in comparison to other animal milks and introduces benefits attributed to camel meat. The up-to-date potential health benefits of fresh and fermented camel milk in vitro and in vivo will be also covered in addition to the link between functional constituents and the functional properties of milk. The authors will review the recent research on the functional properties of camel milk such as the angiotensin converting enzyme, antimicrobial, anticancer, and hypocholesterolic effects. Featuring research on topics such as colostrum composition, meat production, and nutritional value, this book is ideally designed for health professionals, environmentalists, dieticians, food industry professionals, researchers, academicians, and students seeking coverage on the compositional and physiological aspects of camel products.

Topics Covered

The many academic areas covered in this publication include, but are not limited to:

- Anti-Diabetic Effect
- Camel Farming
- Camel Gelatin
- Camel Hair
- Camel History
- Camel Meat
- Camel Milk Cheese
- Camel Milk Composition
- Camel Milk Preservation
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Handbook of Research on

Health and Environmental Benefits of Camel Products



Omar Amin Athaj, Bernard Fayo,
and Rajendra Prasad Agrawal

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Chapter 14

Camel Gelatin Composition, Properties, Production, and Applications

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ABSTRACT

Gelatin is an important protein produced through partial hydrolysis of collagen from animal parts and byproducts such as cartilage, bones, tendons, and hides. The ability of gelatin to form a thermo-reversible gel at normal body temperature and high water content make it an exceptional food ingredient. A good quality gelatin is translucent, brittle, colorless (sometimes slightly yellow), bland in taste, and odorless. Gelatin has been found useful as stabilizer and filler in dairy products and other food industries. Recently, the global gelatin production net over 300,000 metric tons: 46% were from pigskin, 29.4% from bovine hides, 23.1% from bones, and 1.5% from other parts. Although camels have been recognized as source of meat and milk, utilization of camel bones and skins for gelatin production has not been fully explored. This chapter will discuss the processing of camel gelatin extraction.

INTRODUCTION

Gelatin is an important protein produced through partial hydrolysis of collagen from animal parts and byproducts such as cartilages, bones, tendons and hides. The ability of gelatin to form a thermo-reversible gel at normal body temperature and its ability to retain large amounts of water makes it a unique food ingredient. A good quality gelatin is translucent, brittle, colorless (sometimes slightly yellow), bland in taste and odorless. Gelatin has been found useful as a stabilizer and filler in dairy products (see Chapter 5) and other food industries (Mariod & Adam, 2013). Recently, the net global gelatin production was over 300,000 metric tons; 46% were from pigskin, 29.4% from bovine hides, 23.1% from bones and 1.5% from other parts or animals (Zilhada, Harahap, Jaswir, & Effionora, 2018). Although camels have been recognized as a source of meat (see Chapter 12 and 13) and milk (see Chapter 2), utilization of camel's bones and skins for gelatin production has not been fully explored.

Bone gelatin is primarily used for pharmaceutical purposes because of its high level of purity. Prior to extraction of gelatin from bone samples, the bones must be demineralized using dilute acid solution to remove inherent calcium that is part of the bone matrix (Harahap, Jaswir, & Anwar, 2016). Structurally, the function of calcium salt deposited in the organic matrix of bone is to maintain the bone integrity by holding the scaffolds and crosslinks that improves bone strength and rigidity. Removal of calcium salt from bone through acidulation with dilute acid is an essential step towards successful gelatin production since the results of the acid treatment produces bone protein (collagen) which contained water-soluble gelatin. Extraction temperature, pH and extraction period are common operating parameters influencing gelatin production (Gehan, El-Bassyouni, & Abdel-Fattah, 2013). The effect of processing conditions on the properties of gelatin from fish bone with pretreatment with hydrochloric acid has been reported (TaHERi, Abedian Kenari, Gildberg, & Behnam, 2009). Adoption of specific processing parameters and raw material sources often improve the consistency in functionality of gelatin or collagen.

Recently, there has been increase interest in the effective use of underutilized resources and industrial wastes to reduce production cost and environmental hazards. Utilization of animal bone for gelatin production offers opportunities including waste to wealth and waste minimization.

Gelatins from bovine and porcine sources are becoming less acceptable because of increasing allergen cases and tradition or religious believes. This has called for production of gelatin from other sources. Therefore, camel bone gelatin can be a good alternative source of gelatin. However, there has been less effort to identify processing conditions for demineralization of camel bone. The developed demineralization processing conditions for cattle bone are kept as company secret, and conflicting values have been reported. This Chapter will discuss various aspects of the processing of gelatin, particularly camel gelatin extraction, regulations and standards, physico-chemical characteristics, as well as the application of gelatins.

MANUFACTURING OF GELATIN

The typical commercial sources of gelatin are of mammalian origin, mainly pigs and cows. Their bones, skins, and hides are used. Gelatin from these sources form strong gels with good properties. However, there has been a rise in concerns that gelatin might transmit diseases such as mad cow disease and for

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About the Contributors

Omar Alhaj has an excellent expertise in Dairy Biotechnology and currently working at University of Petra, Jordan. His Ph.D. and MSc. were awarded from Wales University, United Kingdom. He served as teaching professor and industry consultant at a number of institutions. He has been granted a number of research project funds in his field. He authored over 30 manuscripts and book chapters in reputable journals and publishers, and he served as reviewer for several peer reviewed reputable journals and has a number of international research collaborations worldwide.

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* * *

Issa Al-Amri is currently holding the positions of Director of DARIS Research Center, Associate Professor of Biology, and Assistant Dean at the University of Nizwa, Oman. Previously worked at Sultan Qaboos University as the Director of Electron Microscopy Unit, Department of Pathology, College of Medicine & Health Sciences. Received BSc from Glasgow Caledonian University (UK), MSc from

University of Wales (UK) and PhD from University of Portsmouth (UK). More than 30 years of experience and over 90 publications. Research interests focused on life sciences, reproductive biology, cancer biology, and electron microscopy.

Hiba F. Al-Sayyed is an assistant professor at the Department of Nutrition /Faculty of Pharmacy and Medical Sciences/University of Petra/Amman/Jordan since 2014. She gained her PhD (since 2012), MSc (since 2003), and BSc (since 2000) from the Department of Nutrition and Food Technology/Faculty of Agriculture/The University of Jordan/Amman/Jordan. She aims to spread the science and awareness of nutrition using various tools such as performing related research, nutrition education, counseling, and conducting food analysis. Dr. Hiba is keen in helping people managing their health by having better food choices. She has experience in food analysis (as she was a laboratory technician in the food chemistry laboratories/Jordan Food and Drug Administration for 7 years) and scientific research (as she worked as a research assistant during her PhD studying period). Till date, she has published 13 articles; most of them are related to her PhD thesis on the effect of date palm fruit (*Phoenix dactylifera* L.) on 7,12-dimethylbenz(α)anthracene-induced mammary cancer in Sprague-Dawley rats. Dr. Hiba is dedicated to scientific research; her research interests are: antioxidants, cancer and especially mammary cancer, and community nutrition issues.

Nour El Sahory, a high energy and results- orientated person, had Doctor of Philosophy in clinical nutrition from Queen's university Belfast (QUB, UK), in 2018 and MSc in nutrition and food technology and the functional food from Jordan University of Science & Technology in 2013. She published her MSc research (effect of lupine flour on baking characteristics of gluten free cookies) and many researches during her PhD such as (association between overall fruit and vegetable intake, and sub-types and blood pressure).

Halima El-Hatmi is an Associate Professor at the High Institute of Applied Biology of Medenine (ISBAM) (University of Gabes, Gabes Tunisia) since 2007. She got a Ph.D. (2007) and Advanced Studies Diploma (2000) from the Faculty of Sciences of Sfax (University of Sfax, Tunisia) and an Engineering diploma (1995) in Food Technology from the National School of Engineers of Sfax (University of Sfax, Tunisia). She was the head of Food Technology Department from 2008 to 2011 at the ISBAM. Since 2011, her main achievements in the field of teaching activities are related to the PAQ (Plan d'amélioration de la Qualité dans l'Enseignement Supérieur, Improvement of the Quality of Higher Education in Tunisia Prject. She was the leader of this project for ISBAM entitled "Improvement of the Quality of Practical Teaching in agri-food". This project allowed the implementation of a Foods Technology platform with equipments adapted for practical courses. Within the framework of this project, a congress in 2014 (April 25-27 "AgroInnov: Technologies innovantes pour la production alimentaire (Innovative technologies for food manufacturing") was organized with continuing education courses regarding quality management in the food sector in order to get complementary ressources. Shis research topics and skills are mainly bioactive peptides derived from milk proteins, biochemistry and physico-chemistry of dairy products (mainly camel milk) and valorization of traditional ressources. She supervised 02 PhD (Supervisor or co-supervisor); 05 Students preparing Fundamental master, 03 engineers, more than 40 students preparing applied master and applied Licenses. She participated to research projects as coordinator or as a member (PROCAMED Cod. I-B/1.1/493: Promotion of innovative camel systems and local sectors for sustain-

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able management of Saharan territories (2013-2015) and ARIMNET (AROMATIC: Natural Bioactive Molecules for Safe and Sustainable dairy Products (2018-2020)). She participated to 01 Erasmus+KA2 Project (SPAAT4FOOD). She published 16 Scientific articles in international journals with Impact Factor.

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Yonas Hailu has an MSc and PhD in dairy foods. He is an expert in dairy food chemistry and processing technologies and have been working in these areas for many years. He has worked on milk gelation, cheese maturation, proteolysis, peptide analysis, membrane filtration, drying and concentration of milk proteins, protein analysis, HPLC, milk powder analysis, sensory evaluation, aroma analysis. Currently, working on developing next generation Infant formula. His main area focus are dairy ingredient processing and new product development. Yonas has authored and co-authored more than seventeen articles in reputable journals and presented his findings in international conferences.

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Irwandi Jaswir has been known as a "Halal" Scientist. He contributes to the Muslim Ummah and serves to Islam through his tireless and never-ending studies on the scientific halal-related issues and return the findings back to the Community through research publications, books, book chapters, halal-related training, education, community services, etc. He believes "Halal Science", which includes halal materials as alternative for non halal materials and ingredients, halal authentications, development of rapid method for non-halal contamination, halal food and cosmetics, development of halal standard, etc., will not only be the key element to protect the Muslims from consuming modern consumer products which are much more complex and very prone to non-halal contamination, but also the important component required to build the halal industry that can contribute to economy of Muslim Ummah. The market of halal industry nowadays is expected to be USD 2.5 trillion, unfortunately Muslims do not play their important roles and do not enjoy the huge market yet. He is the 2018 King Faisal International Prize

Laureate in Service to Islam. His commitment in conducting quality researches, coupled with a strong determination to publish quality research papers have a strong encouragement by his University, IIUM. Prof. Irwandi has completed more than 30 research studies, mostly in the area halal food science. Among the topics he researches are: Determination of non-halal substances in food using FTIR; Development of Halal Gelatin from various alternative sources; Development of Halal Nano-Particles from Camel Gelatin (Funded by Saudi Arabia); Portable Electronic Nose for Rapid Detection of Lard and Alcohol in Food and Beverages; Anti-Cancer Compounds from Local Sources, etc. These research projects are funded from various funding agency such as the Ministry of Education (MOE), Ministry of Science, Technology and Innovation (MOSTI), Malaysia and National Plans for Science and Technology (NPST), Kingdom of Saudi Arabia. He also received research grants from Republic of Korea and Japan. To date, Irwandi's has chalked up a remarkable achievement in research which include: more than 180 scientific papers published in reputable international journals; contributed to 40 book-chapters; presented more than 250 research papers in international conferences – including keynote address and invited lectures; written more than 30 non-refereed and mass-media scientific articles. His dedication to research has enabled him to file 5 patents under his name, and his outstanding achievement is recognised both locally and internationally bagging more 60 scientific awards. Most importantly, his outstanding dedication and commitment in research has placed him in the same rank of other renowned scientist with the inclusion of his name in the annual publication of the “Who's Who in the World 2008.” His name is also included in the book “25 Great Indonesian Scientist Abroad” to be published by the Indonesian Government. His current H-index is 24 with 1882 citations (Google Scholar), showing his high credibility as a renowned scholars.

Zeineb Jrad (F) received his Ph.D. in Biological Sciences and Biotechnology from the Higher Institute of Biotechnology at Monastir in 2015. She is a Postdoctoral Fellow in the MOBIDOC Program (Device funded by the European Union under the Support Program for Education, Mobility, Research and Innovation). She works in collaboration between a social-economic organization specializing in the dairy industry “General Creamery”, a research center “Laboratory of wildlife and livestock of the Institute of arid regions of Medenine “and” the technology hall of the Higher Institute of Applied Biology of Medenine, University of Gabes”. Shis research interests include: (i) - Development of an innovative product based on camel milk on an industrial scale and approve its health value as a partial substitution for fresh milk currently marketed. (ii) Development of selected simple and effecient methods using natural and safe antimicrobials and antioxidants, notably some traditionnaly used for ancestarl dairy products, to better protect dromedary and goat raw milk from microbial contamination. She co-supervised 04 students preparing fundamental master, 01 engineer and supervised 10 students preparing applied master and liscences. She participated as a member of research project (i) PROCAMED: Promotion of innovative camel systems and local sectors for sustainable management of Saharan territories (2013-2015) (ii) ARIMNET: AROMATIC- Natural bioactive molecules for safe and substainable dairy products (2018-2020) AND (iii) PRIMA 2018-2020 (ArtiSaneFood: Innovative Bio-interventions and Risk Modelling Approaches for Ensuring Microbial Safety and Quality of Mediterranean Artisanal Fermented Foods) . She published 10 scientific articles in international journals with Impact Factor, 02 scientific articles in indexed journals and 03 publication in national journal. She participated in 10 national and international congress and 15 workshops and training courses.

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