Healthful traditional Japanese diet

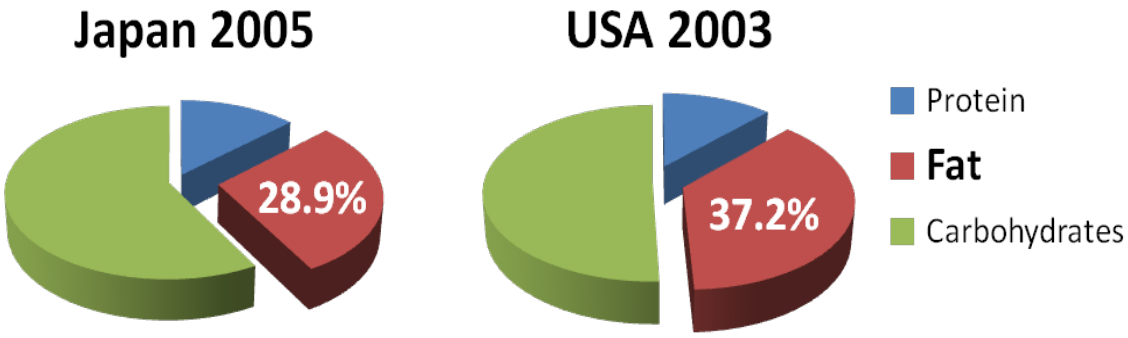
Developing in an isolated environment of mountainous islands with four distinct seasons, surrounded by ocean and marine resources – and with a rigorous craftsman-like tradition of food preparation, preservation and fermentation – the diet of the Japanese people is a product of a traditional food culture which emerged in harmony with its surroundings.

- **Small country with dramatically varied terrain** – Japan has high mountains and coastal plains within a compact land mass, with most areas inhabited, with active foraging and exploration of available food sources. As a result, the diet has a wide variety of tubers, vegetables and wild plants.

- **Four distinct seasons** – A key feature of the Japanese diet is the variety that comes with preparing meals in harmony with the changing of the seasons, fully exploiting seasonal ingredients that are available only briefly.

- **A land embraced by the sea** – Japan's diet reflects a vigorous experimentation and exploration of marine foods. Until very recently in Japan's history, the ocean was effectively the main source of dietary animal proteins. Numerous seaweeds and other marine plants are similarly cherished as food ingredients – perhaps more than in almost any other nation.

Rice is a mainstay offering, accompanied by different styles of miso soup, seasonal vegetables, various seafood, and side dishes and garnishes of a diverse range of ingredients, preparations and flavors. The chief characteristics of the traditional Japanese diet are a wide variety of ingredients, low fat and an optimal nutritional balance.



In Japan, the nutritional benefits of traditional Japanese foods are thought of as a leading factor in the maintenance and promotion of good health.

Growing awareness of "Healthy Diets and Healthy Lives"

How traditional Japanese food ingredients can play a role

Many ingredients in a traditional Japanese diet are not only delicious, but are also abundant in nutrients and other factors with increasingly recognized health benefits.

Some examples:

Konjac/ Shirataki *– Extremely low fat & calories, rich in healthful fiber*

Seaweeds *– High protein, nutrient dense, possible anti-obesity & anti-diabetic effects*

Bean Products *(Soy & Azuki) – Cardio, cholesterol & anti-inflammation benefits, rich in soluble plant fibers*

Fermented foods *(Miso, Soy Sauce, Rice Vinegar) - Nutrient dense, digestive support, antioxidants*

Green Teas *– Low calorie, highly rich in antioxidants*

Fish Products *– Rich source of healthful Omega 3 fats, cardiovascular & brain health benefits*

Editorial Overview

Diet factors could ease disease, build healthier California

Health professionals have long recognized that what we eat can foster wellness or disease. This idea is the focus of the new *2010 Dietary Guidelines for Americans*, the federal guidelines to promote health, reduce chronic disease and diminish overweight and obesity through better nutrition and physical activity.

Today, more than one-third of children and more than two-thirds of adults in the United States are overweight or obese. Investigating the causes and consequences of this health crisis and finding effective responses are key priorities for land-grant universities. As the articles in this special issue demonstrate, UC scientists are pioneering this vital public work, integrating research, education and public service to improve health outcomes.

The 2010 guidelines emphasize the need to balance caloric intake with physical activity. The guidelines encourage Americans to consume more vegetables, fruits, whole grains, fat-free and low-fat dairy products, and seafood, and they recommend an overall diet low in sodium, saturated and trans fats, added sugars and refined grains. Secretary of Agriculture Tom Vilsack stated: "These new and improved dietary recommendations give individuals the information to make thoughtful choices of healthier foods in the right portions and to complement those choices with physical activity. The bottom line is that most Americans need to trim our waistlines to reduce the risk of developing diet-related chronic disease. Improving our eating habits is not only good for every individual and family, but also for our country."

Adopting healthier diets

Few question the guidelines, but many encounter ol stacles to their implementation. Healthier foods are oft unavailable to those who most need them due to high prices, limited access, confusing food labels or insuffic understanding of food preparation options. Trends tow decreased physical activity are reinforced by the natur many jobs, the physical design of communities and the quity of electronic gadgets.

Building on histo expertise in nu education, U poised not to recomn healthy fo options b also to de consume friendly n sages iden what these f are and how can be incor rated into a

Research is elucidating how antioxidants in many foods can improve human health and prevent chronic disease.

diet. Increasingly, UC Cooperative Extension (UCCE) faculty and staff find themselves leading or supporting coalitions to address these issues at the community scale through public policy and planning.

Over the past century, our expectations of food have moved beyond reducing well-recognized nutritional-deficiency diseases (such as scurvy, rickets and pellagra). The research advances of the past decade have enabled us to relate nutrition to chronic disease and aspects of the aging process. Evidence indicates that chronic diseases such as osteoporosis, dementia and cardiovascular disease are also "deficiency diseases" that develop over a long period of time — years or decades. The progression of these deficiency diseases may be modulated by newly recognized dietary factors distinct from the previously characterized essential nutrients. The identification and characterization of such health-promoting dietary factors hold promise for preventing or treating a range of debilitating afflictions.

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California Agriculture magazine explores the linkage between various nutritional elements and good health.

Traditional Japanese soy products

Incredibly versatile, very high-protein & low-fat, with over 3,000 years in cultivation -- soy is one of Asia's culinary gifts to the world, and an irreplaceable staple of the Japanese diet.

In its traditional lightly processed and naturally fermented forms, soy is a healthful and easily digested food with cardiovascular and brain-health benefits increasingly identified in research studies and gaining wide recognition. Soy also shows indications of reducing the risk of osteoporosis and relieving menopausal symptoms.

Naturally fermented soy products, like miso and natto, bring all of these good qualities to the table with the additional benefits of a rich dose of antioxidants.

Traditional soy products in the Japanese diet include:

Tofu, Edamame, Miso, Yuba (tofu skin) and Natto (fermented soybeans).

REVIEW ARTICLE

Soy may help protect against cardiovascular disease

by Emily R. Cena and Francene M. Steinberg

Diet and lifestyle choices are major factors contributing to the risk of cardiovascular disease, which is responsible for more deaths in the United States than any other cause. One dietary component that has received considerable attention for its potential cardioprotective effects is soybeans, which contain lean vegetable protein, dietary fiber and bioactive compounds known as isoflavones. Recent research investigating the relationship between soy and cardiovascular disease has identified several potential mechanisms for the observed protective effects, including cholesterol-lowering properties, antioxidant activity and gene regulation. This review highlights current understanding of the complex relationship between soy and the risk of cardiovascular disease.

Soybeans and foods made from soy are the major source of isoflavones, which serve as antioxidants, scavenging and neutralizing free radicals that might otherwise cause inflammation and increase the risk of heart disease.

Cardiovascular disease — comprised of heart disease, heart failure and stroke — is the leading cause of death in the United States. The estimated combined costs of health care services, medications and lost productivity attributed to cardiovascular disease were more than $475 billion in 2009 (Lloyd-Jones et al. 2009).

Although this chronic inflammatory disease affects the lives of millions of Americans, the development of cardiovascular disease is somewhat preventable. Since diet is arguably the most modifiable risk factor, scientists have devoted a great deal of research to the relationship between dietary choices and cardiovascular disease. A healthy diet is generally high in fruits, vegetables, whole grains and legumes. These plant foods tend to be rich in bioactive compounds, or "extra-nutritional" constituents, that are associated with reducing the risk of cardiovascular disease.

One dietary component of considerable research interest is soybeans, a legume linked to the decreased risk of cardiovascular disease. Epidemiological studies suggest that Asian populations consuming large amounts of soy have lower rates of cardiovascular disease than Western populations (Zhang et al. 2003). In the mid-1990s, a meta-analysis of 29 clinical trials found that compared to animal protein, soy protein significantly reduced blood levels of several lipids (total cholesterol, LDL cholesterol and triglycerides) (Anderson et al. 1995). This prompted the U.S. Food and Drug Administration to approve the current health claim that 25 grams of soy protein per day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.

While an American Heart Association statement issued in 2006 supported the inclusion of soy in the diet, it was not definitive about the protective mechanism of action (Lichtenstein et al. 2006). Research over the past 10 years has reported mixed results due to varying study designs and soy preparations, but the literature overall still supports the conclusion that soy protein with isoflavones can decrease blood levels of LDL cholesterol (Zhan and Ho 2005). Moreover, recent studies suggest that the relationship between soy and cardiovascular disease is more complex than just lowering cholesterol to protect against atherosclerosis.

How soy isoflavones work

Effects. Soybeans provide high-quality vegetable protein, dietary fiber and bioactive compounds called isoflavones, a class of phytochemicals (or plant compounds) that provide health benefits. Many different phytochemicals have been identified in nature and studied for their health effects. For example, anthocyanins found in red, blue and purple fruits and vegetables (such as berries and grapes) have been associated with reduced inflammation and lower risk of heart disease. Sulforaphane, a phytochemical found in broccoli and

Isoflavones are found almost exclusively in soybeans and foods made from soy.

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Traditional Japanese marine products

Surrounded by ocean and abundant marine resources, from ancient times people in Japan developed a diet which contains a relatively large amount of ingredients from the sea. Today, the advantages of a diet heavy in marine products have become more apparent, with research indicating the benefits of Omega 3 fats in the diet -- effects which include inflammation reduction, easing of asthma symptoms, cardiovascular and enhanced brain health.

Marine resources include plants too, and Japan's utilization of various seaweeds and other products is well known, with increasingly strong evidence of health benefits derived from consumption of these traditional Japanese "sea vegetables" as well.

Seaweeds such as konbu and wakame, among others, are extremely rich in minerals and vitamins, high in protein and fiber. Research in Japan hints that their unique "slippery" outer layers may also show promise in lowering cholesterol, with other cardiovascular and anti-cancer benefits as well.

RESEARCH ARTICLE

Dietary omega-3 fatty acids aid in the modulation of inflammation and metabolic health

by Angela M. Zivkovic, Natalie Telis, J. Bruce German and Bruce D. Hammock

This article focuses on the role of omega-3 fatty acids as precursors for lipid signaling molecules known as oxylipins. Although omega-3 fatty acids are beneficial in autoimmune disorders, inflammatory diseases and heart disease, they are generally underrepresented in the American diet. A literature review confirms that the consumption of omega-3 fatty acids — whether in food sources such as walnuts, flax seeds and fatty fish (including salmon and sardines), or in supplements — is associated with decreased morbidity and mortality. This growing body of evidence, including the results of a recent study of patients with kidney disease, highlights the need to measure omega-3 fatty acids and their oxylipin products as markers of metabolic health and biomarkers of disease. In addition, there is substantial evidence of the need to increase the omega-3 fatty acid content of American diets to optimize metabolic health.

Many of the most significant U.S. health concerns today are modulated by omega-3 fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Omega-3 fatty acids are associated with the prevention or reduction in severity of a multitude of diseases, from metabolic diseases such as heart disease, diabetes and kidney disease to neurodegenerative diseases such as Alzheimer's to an array of other inflammatory diseases including osteoarthritis.

EPA and DHA attenuate the development of atherosclerosis, or arterial plaques, by reducing concentrations of inflammatory signaling molecules called cytokines and adhesion molecules at the arterial wall where plaque forms (De Caterina et al. 2004). EPA and DHA have also been shown to stabilize atherosclerotic plaques, thereby reducing the likelihood of fatal and nonfatal cardiovascular events (Thies et al. 2003). EPA and DHA additionally reduce the synthesis of triglycerides (fat molecules) and secretion from the liver, and increase the size of low-density lipoproteins, which contribute to the reduction of cardiovascular disease risk (Griffin et al. 2006). EPA and DHA improve liver health by reducing steatosis (accumulation of fat in the liver) in patients with nonalcoholic fatty liver disease (Capanni et al. 2006). They also improve kidney health by attenuating or even reversing the loss of kidney function and reducing hypertension in kidney diseases involving the glomerulus, the main filtering part of the kidney (Donadio et al. 1994). Omega-3 fatty acids affect the joints and are used as analgesics or pain reducers in rheumatoid arthritis (Goldberg and Katz 2007).

The omega-3s even play a role in brain health: high blood plasma levels of omega-3 fatty acids are associated with a reduced risk of neurodegenerative diseases such as Alzheimer's disease (Schaefer et al. 2006) and mental disorders such as schizophrenia (McNamara et al. 2007) and depression (Sanchez-Villegas et al. 2007). Taken in supplement or food form, omega-3 fatty acids have been found to reverse the progression of a number of inflammatory diseases, from inflammatory bowel disease to diseases of the skin and joints, to other autoimmune diseases such as lupus and multiple sclerosis (Simopoulos 2002). This review focuses on the basic biology of omega-3 fatty acids as nutritional modulators of inflammation and presents preliminary results of a study of oxylipin biomarkers in kidney disease patients.

Intake, food sources and metabolism

Saturated and monounsaturated fatty acids, which have no double bonds or a single double bond, respectively, can be synthesized in the liver. In contrast,

Walnuts, flax seeds and salmon are good sources of omega-3 fatty acids, important nutrients that are generally deficient in American diets.

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RESEARCH ARTICLE

Asthma patients with specific genotypes identified for fish oil treatment trial

by Olga Fortenko, Amir Zeki, Gertrud Schuster, Cristina Davis, Hooman Allayee, Charles Stephensen and Nicholas J. Kenyon

The lifetime prevalence of asthma in California is nearly 20%, and better therapies are needed to manage this common chronic disease. Fish oils containing omega-3 fatty acids are considered a potential therapy for asthma and other inflammatory diseases. Fish oil inhibits the production of arachidonic acid 5-lipoxygenase (ALOX5), an enzyme that exacerbates the lung inflammation that causes asthma. We discuss the genetics of asthma and our preliminary results using a strategy to identify the subgroup of patients who may respond well to treatment with fish oil. These findings, and others, suggest that certain gene polymorphisms of the ALOX5 gene predispose patients to the increased production of inflammatory leukotrienes. Our clinical trials will test the hypothesis that patients with moderate to severe asthma, and with specific high-risk ALOX5 gene sequence variations, will have fewer asthma symptoms when treated with fish oil. The strategy is to decrease the total burden of leukotriene production by supplementing with omega-3 polyunsaturated fatty acids. These studies will also help determine whether genotyping or metabolic profiling (for example, with exhaled breath condensate) can help establish "personalized medicine" for asthma.

Asthma is a chronic inflammatory disorder of the body's lungs that is associated with airway reactivity (or "twitchy" airways) and obstruction. It affects an estimated 25 million people in the United States, including 6 million children. Among adults, asthma accounts for approximately 14 million doctor visits and 2 million emergency room visits annually. The annual cost of asthma nationwide is nearly $15 billion, mostly from hospitalizations and emergency room visits but also the cumulative time lost from school absences and missed work (CDC 2002). Sixty to 80% of the health care dollars dedicated to asthma are spent on caring for patients with difficult-to-control asthma, a subgroup that comprises about 10% of all asthmatics (McFadden and Hejal 2000).

In California, as in much of the country, the prevalence of asthma in children and adults has increased dramatically over the past three decades, straining health system resources. Asthma is a classic disease with "gene-environment" interactions, meaning that there is both a host of genes that are associated with the risk of developing asthma but environmental triggers affect this risk. Asthma triggers in the Central Valley of California, for example, include trees, grasses, pollens, air pollution, ozone and possibly insecticides. Scientists do not know all asthma triggers, and it is still difficult to fully explain the increase in asthma in recent decades.

Approximately 13% of Californians have been diagnosed with asthma, and the chance of developing asthma anytime in life is close to 20% (Meng et al. 2003). There are remarkable disparities in asthma prevalence among different ethnic groups in California: among 5 to 17 year olds, the rates are 27.2% for black, 15.6% for Latino and 18.7% for white children. Emergency room visits for asthma in California are four times higher for blacks than whites (144.5 compared to 35.7 visits per 10,000 residents, respectively). The risk of death is highest for adult black women over age 65 (CDPH 2008).

In 2008, the California Department of Public Health (CDPH) published the *Strategic Plan for Asthma in California: 2008–2012* (CDPH 2008). The document identified the following focus areas: eliminating asthma disparities among ethnic groups, providing asthma education to all

Clockwise from top left, sardines, fish oil pills, flax seeds and soybeans contain omega-3 fatty acids. The omega-3s inhibit the activity of ALOX5, an enzyme that exacerbates lung inflammation and causes asthma.

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Traditional Japanese antioxidant rich products

The possible role of antioxidants in mitigating disease onset truly exemplifies the exciting linkage between diet and health -- certain foods can exhibit almost curative properties, helping to repair damage at a cellular level.

Many traditional Japanese ingredients have been identified as being rich in these potentially restorative antioxidants. These ingredients are also delicious, versatile and can be easily incorporated into various cuisine genres to be enjoyed worldwide.

Japanese green tea is one increasingly well-regarded example, with indications of many therapeutic benefits including for cardiovascular health and reducing risk of certain cancers.

Miso, rice vinegar and soy sauce are all rich in antioxidant compounds as well, and are easily incorporated to the western diet.

Natto may be considered somewhat of an "acquired taste," but this traditional soybean fermentation is antioxidant rich as well as high in protein, low in fat and vitamin dense.

REVIEW ARTICLE

Biofactors in food promote health by enhancing mitochondrial function

by Sonia F. Shenoy, Winyoo Chowanadisai, Edward Sharman, Carl L. Keen, Jiankang Liu *and* Robert B. Rucker

Mitochondrial function has been linked to protection from and symptom reduction in chronic diseases such as heart disease, diabetes and metabolic syndrome. We review a number of phytochemicals and biofactors that influence mitochondrial function and oxidative metabolism. These include resveratrol found in grapes; several plant-derived flavonoids (quercetin, epicatechin, catechin and procyanidins); and two tyrosine-derived quinones, hydroxytyrosol in olive oil and pyrroloquinoline quinone, a minor but ubiquitous component of plant and animal tissues. In plants, these biofactors serve as pigments, phytoalexins or growth factors. In animals, positive nutritional and physiological attributes have been established for each, particularly with respect to their ability to affect energy metabolism, cell signaling and mitochondrial function.

One of the most promising current areas of nutritional research focuses on plant compounds with positive health effects that extend beyond the functions of well-recognized essential vitamins, minerals and macronutrients (Rice-Evans and Packer 2003). Identifying such compounds and studying their mechanisms of action have been important activities of the UC Davis Center for Health and Nutrition Research (CHNR) (table 1).

Many of the human health–related biofactors in plants (e.g., various pigments, secondary metabolites and phytoalexins) have evolved to provide protective camouflage, repel predators or facilitate the transformation of specific wavelengths of light into chemical energy. Our food exposes us to thousands of such "xenobiotic" compounds (external chemicals that our body does not normally produce) that must be either eliminated or put to novel uses in the body. Many xenobiotics in foods can influence specific metabolic functions, acting as bioactive factors (biofactors). For example, epidemiological studies have shown a correlation between foods high in bioactive factors such as flavonoids and the decreased risk of chronic diseases such as vascular disease and gastrointestinal tract cancers (Rice-Evans and Packer 2003; Wallace 2011). While we still have only a rudimentary understanding of how these bioactive compounds work, they can have profound and often specific effects on mitochondria (see page 136).

Biofactors in food that enhance mitochondrial function include resveratrol, quercetin, procyanidins, catechins, hydroxytyrosol and pyrroloquinoline quinone (fig. 1). Although it is easy to overstate mitochondria-related health claims, a broad range of healthful attributes has been described and validated for each of these compounds.

Biofactors in food play a role in enhancing mitochondrial function, thereby decreasing the risk of some chronic diseases. *Top*, a mouse that has been deprived of pyrroloquinoline quinone (PQQ), a ubiquitous bacterial compound found in fermented products, tea, cocoa and legumes. *Above*, a mouse fed a diet containing PQQ.

Biological properties of resveratrol

Resveratrol is a stilbenoid (a type of natural polyphenolic compound) and a phytoalexin, a class of compounds produced by some plants when under attack by pathogens such as bacteria or fungi. It is found predominately in purple grapes and juice, red wine, peanuts and some berries (Xia et al. 2010). In animals, resveratrol also has potent biological properties that have been reported to range from cardio-protection to enhanced neuronal activity. As examples, resveratrol exposure has been associated with longer life spans in yeast and in short-lived invertebrates, such as *Caenorhabditis elegans*

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REVIEW ARTICLE

Well-functioning cell mitochondria promote good health

by Winyoo Chowanadisai, Sonia F. Shenoy, Edward Sharman, Carl L. Keen, Jiankang Liu and Robert B. Rucker

Mitochondrial function can be directly linked to protection from certain chronic diseases and conditions, such as heart disease, diabetes, metabolic syndrome and chronic inflammation, as well as the aging processes. Mitochondria are central to normal glucose, amino acid and fatty acid metabolism, in addition to antioxidant modulation and virtually all aspects of cell turnover and maintenance. Nutrition plays an essential role in optimizing such functions. We describe strategies for the regulation of mitochondria, as well as metabolic strategies for dealing with the thousands of compounds in plants and animal tissues that are metabolically important. Many of these compounds function to signal the up- or downregulation of mitochondria or act as antioxidants.

Mitochondria are the organelles in all cells that break down nutrients and produce energy for the body's myriad functions. Nutrition plays a critical role in the process of mitochondriogenesis, and poor nutrition can subsequently lead to health problems.

Aging and many chronic diseases and conditions such as heart disease, diabetes, metabolic syndrome and inflammation are affected by mitochondria, organelles that break down nutrients and produce most of the energy in our cells. These organelles act as the cell's chief metabolic control center, converting substances from the foods we eat into energy for essential functions. To generate the adenosine triphosphate (ATP) that powers most of the chemical reactions in cells, mitochondria use oxygen to help break down (metabolize) glucose, amino acids and fatty acids. Because this process requires oxygen, it is called cellular respiration. The control of oxygen use and respiration is central to normal growth and development, affecting virtually all aspects of the metabolism of glucose, amino acids and fatty acids and the modulation of reactive oxygen species (ROS) that can damage cells (Lane 2006).

Mitochondria regulate these processes with great precision. For example, consider that over the course of a year, whether slender or obese, each of us consumes hundreds of pounds of food, yet our body weight usually does not vary more than a pound. Mitochondria are also key to regulating body temperature: the human production and use of ATP is equivalent to about 10,000 times more heat per day than that produced by an equal mass of the sun. Mitochondrial control of ATP production helps keep us from boiling in our own juices or even raising our body temperature a few degrees, except on rare occasions (Lane 2006; Scheffler 2007).

Editor's note: This article describes important functions and characteristics of mitochondria. It is the basis for the next article, "Biofactors in food promote health by enhancing mitochondrial function" (page 141), which describes the actions of specific food components as cellular signals for mitochondriogenesis.

Regulation of mitochondria

The mechanisms for mitochondrial regulation include (1) changes in the number of mitochondria per cell, (2) control of the assembly and disassembly of mitochondria (turnover), (3) changes in the size and surface area of mitochondria and (4) regulation of the numerous catalytic steps important to the control of body fuel utilization, heat and ATP production. Besides the nucleus of the cell, mitochondria are the only cellular organelle in animals that contains a distinct set of genes as well as the machinery to manufacture some of its own messenger RNAs and proteins. Of the approximately 25,000 genes that make up the human genome, about 0.1% are found exclusively in the mitochondria (Scheffler 2007).

Indeed, mitochondrial DNA (mtDNA) has a separate evolutionary origin, being derived from the circular genomes of bacteria that were engulfed by early ancestors of the eukaryotic cells in today's

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