Coconut: In Support of Good Health in the 21st Century

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Coconuts play a unique role in the diets of mankind because they are the source of important physiologically functional components. These physiologically functional components are found in the fat part of whole coconut, in the fat part of desiccated coconut, and in the extracted coconut oil.

Lauric acid, the major fatty acid from the fat of the coconut, has long been recognized for the unique properties that it lends to nonfood uses in the soaps and cosmetics industry. More recently, lauric acid has been recognized for its unique properties in food use, which are related to its antiviral, antibacterial, and antiprotozoal functions.

Now, capric acid, another of coconut's fatty acids has been added to the list of coconut's antimicrobial components. These fatty acids are found in the largest amounts only in traditional lauric fats, especially from coconut. Also, recently published research has shown that natural coconut fat in the diet leads to a normalization of body lipids, protects against alcohol damage to the liver, and improves the immune system's anti-inflammatory response.

Clearly, there has been increasing recognition of health- supporting functions of the fatty acids found in coconut. Recent reports from the U.S. Food and Drug Administration about required labeling of the trans fatty acids will put coconut oil in a more competitive position and may help return to its use by the baking and snack food industry where it has continued to be recognized for its functionality. Now it can be recognized for another kind of functionality: the improvement of the health of mankind.

Functional Properties Of Lauric Fats As Antimicrobials

As a functional food, coconut has fatty acids that provide both energy (nutrients) and raw material for antimicrobial fatty acids and monoglycerides (functional components) when it is eaten. Desiccated coconut is about 69% coconut fat, as is creamed coconut. Full coconut milk is approximately 24% fat.

Approximately 50% of the fatty acids in coconut fat are lauric acid.

Lauric acid is a medium chain fatty acid, which has the additional beneficial function of being formed into monolaurin in the human or animal body.

Monolaurin is the antiviral, antibacterial, and antiprotozoal monoglyceride used by the human or animal to destroy lipid-coated viruses such as HIV, herpes, cytomegalovirus, influenza, various pathogenic bacteria, including listeria monocytogenes and helicobacter pylori, and protozoa such as giardia lamblia. Some studies have also shown some antimicrobial effects of the free lauric acid.

Also, approximately 6-7% of the fatty acids in coconut fat are capric acid.

Capric acid is another medium chain fatty acid, which has a similar beneficial function when it is formed into monocaprin in the human or animal body.

Monocaprin has also been shown to have antiviral effects against HIV and is being tested for antiviral effects against herpes simplex and antibacterial effects against chlamydia and other sexually transmitted bacteria.

The food industry has, of course, long been aware that the functional properties of the lauric oils, and especially coconut oil, are unsurpassed by other available commercial oils. Unfortunately, in the U.S., both during the late 1930s and again during the 1980s and 1990s, the commercial interests of the U.S. domestic fats and oils industry were successful in driving down usage of coconut oil.

As a result, in the U.S. and in other countries where the influence from the U.S. is strong, the manufacturer has lost the benefit of the lauric oils in its food products. As we will see from the data I will present in this talk, it is the consumer who has lost the many health benefits that can result from regular consumption of coconut products.

The antiviral, antibacterial, and antiprotozoal properties of lauric acid and monolaurin have been recognized by a small number of researchers for nearly four decades: this knowledge has resulted in more than 20 research papers and several U.S. patents, and this past year it resulted in a comprehensive book chapter, which reviewed the important aspects of lauric oils as antimicrobial agents (Enig 1998).

In the past, the larger group of clinicians and food and nutrition scientists has been unaware of the potential benefits of consuming foods containing coconut and coconut oil, but this is now starting to change.

Kabara (1978) and others have reported that certain fatty acids (FAs) (e.g., medium-chain saturates) and their derivatives (e.g., monoglycerides (MGs)) can have adverse effects on various microorganisms: those microorganisms that are inactivated include bacteria, yeast, fungi, and enveloped viruses.
Additionally, it is report-ed that the antimicrobial effects of the FAs and MGs are additive, and total concentration is critical for inactivating viruses (Isaacs and Thormar 1990).

The properties that determine the anti-infective action of lipids are related to their structure: e.g., monoglycerides, free fatty acids.

The monoglycerides are active; diglycerides and triglycerides are inactive. Of the saturated fatty acids, lauric acid has greater antiviral activity than either caprylic acid (C-8), capric acid (C-10), or myristic acid (C-14). In general, it is reported that the fatty acids and monoglycerides produce their killing/inactivating effect by lysing the plasma membrane lipid bilayer.

The antiviral action attributed to monolaurin is that of solubilizing the lipids and phospholipids in the envelope of the virus, causing the disintegration of the virus envelope. However, there is evidence from recent studies that one antimicrobial effect in bacteria is related to monolaurin's interference with signal transduction (Projan et al 1994), and another antimicrobial effect in viruses is due to lauric acid's interference with virus assembly and viral maturation (Hornung et al 1994).

Recognition of the antiviral aspects of the antimicrobial activity of the monoglyceride of lauric acid (monolaurin) has been reported since 1966. Some of the early work by Hierholzer and Kabara (1982) that showed virucidal effects of monolaurin on enveloped

RNA and DNA viruses was done in conjunction with the Center for Disease Control of the U.S. Public Health Service.

These studies were done with selected virus prototypes or recognized representative strains of enveloped human viruses. The envelope of these viruses is a lipid membrane, and the presence of a lipid membrane on viruses makes them especially vulnerable to lauric acid and its derivative monolaurin.

The medium-chain saturated fatty acids and their derivatives act by disrupting the lipid membranes of the viruses (Isaacs and Thormar 1991; Isaacs et al 1992). Research has shown that enveloped viruses are inactivated in both human and bovine milk by added fatty acids and monoglycerides (Isaacs et al 1991), and also by endogenous fatty acids and monoglycerides of the appropriate length (Isaacs et al 1986, 1990, 1991, 1992; Thormar et al 1987).

Some of the viruses inactivated by these lipids are

- HIV
- measles
- herpes simplex (HSV-1)
- vesicular stomatitis virus
- visna virus
- cytomegalovirus (CMV)

Many of the pathogenic organisms reported to be inactivated by these antimicrobial lipids are those known to be responsible for opportunistic infections in HIV-positive individuals. For example, concurrent infection with cytomegalovirus is recognized as a serious complication for HIV+ individuals (Macallan et al 1993).

Thus, it would appear to be important to investigate the practical aspects and the potential benefit of an adjunct nutritional support regimen for HIV-infected individuals, which will utilize those dietary fats that are sources of known antiviral, antimicrobial, and antiprotozoal monoglycerides and fatty acids such as monolaurin and its precursor lauric acid.

Until now, no one in the mainstream nutrition community seems to have recognized the added potential of antimicrobial lipids in the treatment of HIV-infected or AIDS patients. These antimicrobial fatty acids and their derivatives are essentially nontoxic to man; they are produced in vivo by humans when they ingest those commonly available foods that contain adequate levels of medium-chain fatty acids such as lauric acid.

According to the published research, lauric acid is one of the best "inactivating" fatty acids, and its monoglyceride is even more effective than the fatty acid alone (Kabara 1978, Sands et al 1978, Fletcher et al 1985, Kabara 1985).

The lipid-coated (envelope) viruses are dependent on host lipids for their lipid constituents. The variability of fatty acids in the foods of individuals as well as the variability from de novo synthesis accounts for the variability of fatty acids in the virus envelope and also explains the variability of glycoprotein expression, a variability that makes vaccine development more difficult.

Monolaurin does not appear to have an adverse effect on desirable gut bacteria, but rather on only potentially pathogenic microorganisms.

For example, Isaacs et al (1991) reported no inactivation of the common Escherichia coli or Salmonella enteritidis by monolaurin, but major inactivation of Hemophilus influenzae, Staphylococcus epidermidis and Group B gram positive streptococcus.

The potentially pathogenic bacteria inactivated by monolaurin include Listeria monocytogenes, Staphylococcus aureus, Streptococcus agalactiae, Groups A,F & G streptococci, gram-positive organisms, and some gram-negative organisms if pretreated with a chelator.

Decreased growth of Staphylococcus aureus and decreased production of toxic shock syndrome toxin-1 was shown with 150 mg monolaurin per liter (Holland et al 1994). Monolaurin was 5000 times more inhibitory against Listeria monocytogenes than ethanol (Oh & Marshall 1993). Helicobacter pylori is rapidly inactivated by medium-chain monoglycerides and lauric acid, and there appears to be very little development of resistance of the organism to the bactericidal effects (Petschow et al 1996) of these natural antimicrobials.

A number of fungi, yeast, and protozoa are inactivated or killed by lauric acid or monolaurin. The fungi include several species of ringworm (Isaacs et al 1991). The yeast reported is Candida albicans (Isaacs et al 1991). The protozoan parasite Giardia lamblia is killed by free fatty acids and monoglycerides from hydrolyzed human milk (Hernell et al 1986, Reiner et al 1986, Crouch et al 1991, Isaacs et al 1991). Numerous other protozoa were studied with similar findings; these findings have not yet been published (Jon J. Kabara, private communication, 1997).

Research continues in measuring the effect of the monoglyceride derivative of capric acid monocaprin as well as the effects of lauric acid. Chlamydia trachomatis is inactivated by lauric acid, capric acid, and monocaprin (Bergsson et al 1998), and hydrogels containing monocaprin are potent in vitro inactivators of sexually transmitted viruses such as HSV-2 and HIV-1 and bacteria such as Neisseria gonorrhoeae (Thormar 1999).

Origins Of The Anti-Saturated Fat Agenda

The coconut industry has suffered more than three decades of abusive rhetoric from the consumer activist group Center for Science in the Public Interest (CSPI), from the American Soybean Association (ASA) and other members of the edible oil industry, and from those in the medical and scientific community who learned their misinformation from groups like CSPI and ASA. I would like to review briefly the origins of the anti-saturated fat, anti-tropical oil campaigns and hopefully give you some useful insight into the issues.

When and how did the anti-saturated fat story begin?

It really began in part in the late 1950s, when a researcher in Minnesota announced that the heart disease epidemic was being caused by hydrogenated vegetable fats. The edible oil industry's response at that time was to claim it was only the saturated fat in the

hydrogenated oils that was causing the problem. The industry then announced that it would be changing to partially hydrogenated fats and that this would solve the problem.

In actual fact, there was no change because the oils were already being partially hydrogenated, and the levels of saturated fatty acids remained similar, as did the levels of the trans fatty acids. The only thing that really changed was the term for hydrogenation or hardening listed on the food label.

During this same period, a researcher in Philadelphia reported that consuming polyunsaturated fatty acids lowered serum cholesterol. This researcher, however, neglected to include the information that the lowering was due to the cholesterol going into the tissues, such as the liver and the arteries.

As a result of this research report and the acceptance of this new agenda by the domestic edible oils industries, there was a gradual increase in the emphasis on replacing "saturated fats" in the diet and on the consuming of larger amounts of the "polyunsaturated fats."

As many of you probably know, this strong emphasis on consuming polyunsaturates has backfired in many ways: the current adjustments being recommended in the U.S. by groups such as the National Academy of Sciences replace the saturates with monounsaturates instead of with polyunsaturates and replace polyunsaturates with monounsaturates.

Early promoters of the anti-saturated fat ideas included companies such as Corn Products Company (CPC International) through a book written by Jeremiah Stamler in 1963, with the professional edition published in 1966 by CPC. This book took some of the earliest pejorative stabs at the tropical oils.

In 1963, the only tropical fat or oil singled out as high in saturated fats was coconut oil. Palm oil had not entered the U.S. food supply to any extent, had not become a commercial threat to the domestic oils, and was not recognized in any of the early texts. An observation by the editorial staff of Consumer Reports noted that

"...in 1962...one writer observed, the average American now fears fat (saturated fat, that is) 'as he once feared witches.'"

In 1965, a representative of Procter and Gamble told the American Heart Association to change its Diet/Heart statement, removing any reference to the trans fatty acids. This altered official document encouraged the consumption of partially hydrogenated fats.

In the 1970s, this same Procter and Gamble employee served as nutrition chairman in two controlling positions for the National Heart Lung and Blood Institute's Lipid Research Clinic (LRC) trials and as director of one of the LRC centers. These LRC trials were the basis for the 1984 NIH Cholesterol Consensus Conference, which in turn spawned the National Cholesterol Education Program (NCEP).

This program encourages consumption of margarine and partially hydrogenated fats, while admitting that trans should not be consumed in excess. The official NCEP document states that "...coconut oil, palm oil, and palm kernel oil...should be avoided..."

In 1966, the U.S. Department of Agriculture documents on fats and oils talked about how unstable the unsaturated fats and oils were.
There was no criticism of the saturated fats. That criticism of saturated fat was to come later to this agency when it came under the influence of the domestic edible fats and oils industry, and when it developed the U.S. Dietary Guidelines.

These Dietary Guidelines became very anti-saturated fat and remain so to this day. Nevertheless, as we will learn later in my talk, there has started some reversal of the anti-saturated fat stance in the works in this agency in 1998.

In the early 1970s, although a number of researchers were voicing concerns about the trans fats, the edible oil industry and the U.S. Food and Drug Administration (FDA) were engaging in a revolving-door exchange that would:

- promote the increasing consumption of partially hydrogenated vegetable oils
- would condemn the saturated fats
- hide the trans issue

As an example of this "oily" exchange, in 1971 the FDA's general counsel became president of the edible oil trade association, and he in turn was replaced at the FDA by a food lawyer who had represented the edible oil industry.

From that point on, the truth about any real effects of the dietary fats had to play catch-up. The American edible oil industry sponsored "information" to educate the public, and the natural dairy and animal fats industries were inept at countering any of that misinformation.

Not being domestically grown in the U.S., coconut oil, palm oil, and palm kernel oil were not around to defend themselves at that time.

The government agencies responsible for disseminating information ignored those protesting "lone voices," and by the mid-1980s, American food manufacturers and consumers had made major changes in their fats and oils usage -- away from the safe saturated fats and headlong into the problematic trans fats.

The Damaging Role Of The U.S. Consumer Activist Group CSPI

Some of the food oil industry (especially those connected with the American Soybean Association (ASA)) and some of the consumer activists (especially the Center for Science in the Public Interest (CSPI) and also the American Heart Savers Association) further eroded the status of natural fats when they sponsored the major anti-saturated fat, anti-tropical oils campaign in the late 1980s.

Actually, an active anti-saturated fat bias started as far back as 1972 in CSPI. But beginning in 1984, this very vocal consumer activist group started its anti-saturated fat campaign in earnest. In particular, at this time, the campaign was against the "saturated" frying fats, especially those being used by fast-food restaurants. Most of these so-called saturated frying fats were tallow based, but also included was palm oil in at least one of the hotel/restaurant chains.

Then in a "News Release" in August 1986, CSPI criticized what it called "Deceptive Vegetable Oil Labeling: Saturated Fat Without The Facts," referring to "palm, coconut, and palm kernel oil" as "rich in artery-clogging saturated fat."

CSPI further announced that it had petitioned the Food and Drug Administration to stop allowing labeling of foods as having "100% vegetable shortening" if they contained any of the "tropical oils." CSPI also asked for mandatory addition of the qualifier "a saturated fat" when coconut, palm or palm kernel oils were named on the food label.

In 1988, CSPI published a booklet called "Saturated Fat Attack." This booklet contained lists of processed foods "surveyed" in Washington, DC supermarkets. The lists were used for developing information about the saturated fat in the products.

Section III is entitled "Those Troublesome Tropical Oils," and it contains statements encouraging pejorative labeling. There were lots of substantive mistakes in the booklet, including errors in the description of the biochemistry of fats and oils and completely erroneous statements about the fat and oil composition of many of the products.

At the same time CSPI was conducting its campaign in 1986, the American Soybean Association began its anti-tropical oil campaign by sending inflammatory letters, etc., to soybean farmers. The ASA took out advertisements to promote a "Tropical Fat Fighter Kit." The ASA hired a Washington DC "nutritionist" to survey supermarkets to detect the presence of tropical oils in foods.

Then early in 1987, the ASA petitioned the FDA to require labeling of "Tropical Fats," and by mid-1987, the Soybean Digest continued an active and increasing anti-tropical oils campaign.

At about the same time (June 3, 1987), the New York Times published an editorial, "The Truth About Vegetable Oil," in which it called palm, palm kernel, and coconut oils "the cheaper, artery-clogging oils from Malaysia and Indonesia" and claimed that U.S. federal dietary guidelines opposed tropical oils, although it is not clear that this was so. The "artery-clogging" terminology was right out of CSPI.

Two years later in 1989, the ASA held a press conference with the help of the CSPI in Washington DC in an attempt to counter the palm oil group's press conference of March 6. The ASA "Media Alert" stated that the National Heart Lung and Blood Institute and National Research Council "recommend consumers avoid palm, palm kernel and coconut oils."

Only months before these press conferences, millionaire Phil Sokolof, the head of the National Heart Savers Association (NHSA), purchased the first of a series of anti-saturated fats and anti-tropical fats advertisements in major newspapers. No one has found an overt connection between Sokolof (and his NHSA) and the ASA, but the CSPI bragged about being his advisor.