with controls. Dryness and elasticity of skin were also improved. Further research is needed to confirm or refute these findings.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

Yeast beta-glucan is contraindicated in those who are hypersensitive to any component of a yeast beta-glucan containing product.

PRECAUTIONS

Pregnant women and nursing mothers should avoid yeast beta-glucan supplementation.

INTERACTIONS

DRUGS

Antibiotics, antifungal agents, cancer chemotherapeutic agents: Animal studies have shown some synergistic effects when these substances were used concomitantly with yeast beta-glucan.

OVERDOSAGE

There are no reports of overdosage.

DOSAGE AND ADMINISTRATION

The introduction of yeast beta-glucan supplements has been recent. There are no typical doses.

LITERATURE

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Yogurt

DESCRIPTION

Yogurt is a coagulated milk product that results from the fermentation of milk by the bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus.* In addition to *L. bulgaricus* and *S. thermophilus*, other members of the *Lactobacillus* genus, such as *L. acidophilus* and other lactic acid-bacteria, can be used in the process of producing yogurt. Collectively, the bacteria used to make yogurt are called lactic acid bacteria (LAB). All of the LAB produce lactic acid. The acid fermentation curdles the milk and preserves it from putrefaction and spoilage. For centuries, many have believed that fermented milk products such as yogurt are beneficial for health. Elie Metchnikoff, the father of modern immunology, wrote in his book, *The Prolongation of Life: Optimistic Studies*, that yogurt was beneficial for gastrointestinal health, as well as for the promotion of longevity. Some recent research on yogurt suggests that it may have immunostimulatory effects, as well as other benefits.

ACTIONS AND PHARMACOLOGY

ACTIONS

Yogurt may have immunostimulatory and other immunomodulatory activities. It may also have hypocholesterolemic activity.

MECHANISM OF ACTION

The possible immunostimulatory activity of yogurt is probably due to the presence of lactic acid bacteria, as well as nonbacterial components of yogurt. The cell wall of lactic acid bacteria is composed of peptidoglycans, teichoic acid and polysaccharides. The peptidoglycans may induce adjuvant activity at the mucosal surface. Muramyl dipeptide, a lower-molecular-weight breakdown product of the peptidoglycans, may stimulate cytokine production by macrophages, monocytes and lymphocytes. Teichoic acid may also stimulate the production of certain cytokines by monocytes. The lactic acid bacteria may increase secretory IgA activity in the gastrointestinal tract, as well.

Nonbacterial components of yogurt may also contribute to the possible immunostimulatory activity of yogurt. Oligopeptides produced via the fermentation process may enhance phagocytic activity. Some bioactive peptides resulting from the fermentation process may stimulate the proliferation and maturation of T lymphocytes and natural killer (NK) cells for defense against pathogenic enteric bacteria.

Yogurt may have a higher concentration of conjugated linoleic acid (CLA) than nonfermented milk. CLA may have immunomodulatory and anticarcinogenic activity, among other possible health benefits (see Conjugated Linoleic Acid). Whey proteins found in yogurt may be another nonbacterial contributor to yogurt's possible immunostimulatory and other beneficial activities. Whey proteins (see Whey Proteins) are especially high in L-cysteine, a key precursor in the biosynthesis of the tripeptide glutathione. Glutathione has antioxidant activity and is involved in the detoxification of many xenobiotics, including some carcinogens. Whey proteins, in addition to their involvement in the

synthesis of glutathione, may have immunomodulatory activities.

The mechanism of the possible anti-allergic activity of yogurt is unclear. It is speculated that yogurt may stimulate interferon-gamma production, which in turn may modulate T cell function by downregulating the Th-2 response.

Some studies have suggested a possible hypocholesterolemic activity of yogurt. Again, the mechanism of this possible effect is unclear. It has been speculated that hydroxymethylglutarate in yogurt may inhibit hydroxymethylglutarate coenzyme A (HMG CoA) reductase activity.

PHARMACOKINETICS

The proteins, peptides and amino acids in yogurt are digested, absorbed and metabolized by normal physiological processes. The same is true for the carbohydrates and lipids in yogurt. Most of the lactic acid bacteria in yogurt adhere only temporarily to the mucosa of the colon. Some, *Lactobacillus acidophilus* for example, persist longer. Most of the lactic acid bacteria do not survive stomach acid. Again, some, such as *L. acidophilus*, are more resistant to stomach acid.

INDICATIONS AND USAGE

Yogurt may have a variety of positive immunologic effects and may help fight certain infections. Yogurt may be anticarcinogenic and antiatherogenic in some circumstances. It may also be useful in some gastrointestinal disorders and in some with allergies and asthma. See also Prebiotics, Probiotics and Symbiotics.

RESEARCH SUMMARY

In vitro, animal and a few human studies indicate that yogurt has a number of favorable immunologic effects. These studies have shown that yogurt consumption increases antibody production, cytokine production, phagocyte activity, natural killer cell activity and T cell function. Both bacterial and non-bacterial components in yogurt have been hypothesized to play roles in these effects on immune function.

In a recent study of long-term yogurt consumption among two different age groups (young adults 20 to 40 years of age and seniors 55 to 70), intake of live-culture yogurt, more than pasteurized yogurt, was associated with decreased allergic symptoms in both age groups. Seniors consuming 200 grams of yogurt daily for one year had consistently lower levels of total immunoglobulin than did control seniors who did not consume yogurt.

Some other studies have also shown that yogurt may be effective in reducing IgE-mediated disorders such as asthma. Results, however, have been mixed, and further research is needed.

Some years ago, a small study suggested that a cup of yogurt daily could significantly reduce the incidence of recurrent vaginitis. The study involved women who had at least five occurrences of vaginitis due to candidal infections annually. The yogurt used in the study was confirmed to contain *Lactobacillus acidophilus*. A three-fold reduction in vaginitis was reported in the women who received yogurt daily for six months.

Various yogurt preparations have been shown to inhibit the growth of several cancers in animal studies. Several of the bacterial components of yogurt have been shown to inhibit tumorigenesis, possibly by reducing nitrite concentrations, through immune-modulation and other mechanisms.

Epidemiological data are somewhat conflicting with respect to yogurt intake and cancer incidence. A significantly lower consumption of fermented milk products (primarily yogurt and buttermilk) was seen among breast-cancer patients in one case-control study. But, in another study, greater yogurt consumption was associated with a higher incidence of ovarian cancer. Further research is needed.

There is some evidence that the bacterial components of yogurt can protect against some gastrointestinal tract infections. Some studies have shown that yogurt products can enhance recovery from some forms of diarrhea. Yogurt has also been used with some success to help restore intestinal microflora diminished by antibiotic treatment. Yogurt is also helpful in some with lactose intolerance.

Several studies spanning many years have concluded that yogurt has hypocholesterolemic effects. In one study, animals were fed high-cholesterol diets. Some were supplemented with yogurt and some were not. The supplemented animals had reduced serum cholesterol and reduced low-density lipoproteins. No effects were noted on serum triglycerides.

Recently, a fermented milk product produced a small but statistically significant reduction in total cholesterol and LDL-cholesterol levels in a double-blind, placebo-controlled, crossover study.

For more information, see Prebiotics, Probiotics and Symbiotics.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

Yogurt is contraindicated in those who are hypersensitive to any component of a yogurt-containing preparation.

PRECAUTIONS

Although yogurt contains much less lactose than nonfermented milk, some with lactase-deficiency may still not be able to tolerate yogurt. Generally, however, it is much better

tolerated by those with lactase-deficiency than nonfermented milk.

ADVERSE REACTIONS

There are some reports of flatulence and diarrhea in some with lactase-deficiency.

OVERDOSAGE

None known.

DOSAGE AND ADMINISTRATION

Yogurt is available in many different preparations. Yogurt may be considered a functional food. In some yogurt preparations, the lactic acid bacteria have been killed during the processing of the product via pasteurization. Yogurt preparations in which the lactic acid bacteria have been killed may still confer some, but probably not all, of the possible health benefits.

Intake of yogurt is variable. One study showing a possible anti-allergy effect of yogurt used 200 grams daily for one year. Unpasteurized yogurt was found to be more effective than pasteurized yogurt in this study.

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Zinc

DESCRIPTION

Zinc is an essential element in human and animal nutrition with a wide range of biological roles. Zinc plays catalytic, structural or regulatory roles in the more than 200 zinc metalloenzymes that have been identified in biological systems. These enzymes are involved in nucleic acid and protein metabolism and the production of energy, among other things. Zinc plays a structural role in the formation of the so-called zinc fingers. Zinc fingers are exploited by transcription factors for interacting with DNA and regulating the activity of genes. Another structural role of zinc is in the maintenance of the integrity of biological membranes resulting in their protection against oxidative injury, among other things.

Zinc is a metallic element with atomic number 30 and an atomic weight of 65.37 daltons. Its atomic symbol is Zn. Zinc exists under physiological conditions in the divalent state. The adult body contains about 1.5 to 2.5 grams of zinc. It is present in all organs, tissues, fluids and secretions. Approximately 90% of total body zinc is found in skeletal muscle and bone. Over 95% of total body zinc is bound to proteins within cells and cell membranes. Plasma contains only 0.1% of total body zinc. Most of the zinc (75% to 88%) in blood is found in the red blood cell zinc metalloenzyme carbonic anhydrase. In the plasma, approximately 18% of zinc is bound to alpha-2-macroglobulin, 80% to albumin and 2% to such proteins as transferrin and ceruloplasmin.

Physiologically, zinc is vital for growth and development, sexual maturation and reproduction, dark vision adaptation, olfactory and gustatory activity, insulin storage and release and for a variety of host immune defenses, among other things. Zinc deficiency can result in growth retardation, immune dysfunction, increased incidence of infections, hypogonadism, oligospermia, anorexia, diarrhea, weight loss, delayed wound healing, neural tube defects of the fetus, increased risk for abortion, alopecia, mental lethargy and skin changes.

Moderate to severe zinc deficiency is rare in industrialized countries. However, it is highly prevalent in developing countries. Many, however, are at risk for mild zinc deficiency in industrialized countries. Several diseases and situations predispose to zinc deficiency, including the autosomal recessive disease acrodermatitis enteropathica, alcoholism, malabsorption, thermal burns, total parenteral nutrition (TPN) without zinc supplementation and certain drugs, such as diuretics, penicillamine, sodium valproate and ethambutol. Zinc intake in many of the elderly may be suboptimal and, if compounded with certain drugs and diseases, can lead to mild or even moderate zinc deficiency.

Zinc acetate is an FDA-approved orphan drug for the treatment of the copper-overload disorder Wilson's disease.