

Extension of AOAC Official Method 999.14 (Choline in Infant Formula and Milk) to the Determination of Choline in Dietary Supplements

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AOAC Official Method 999.14 is applicable for the determination of choline in milk and infant formulas. To date, its use has not been extended beyond these matrices. We modified Official Method 999.14 and applied it to the determination of choline in a range of choline-containing dietary supplements. Dietary supplement tablets, capsules, wafers, softgels, liquid products, and drink powders were included. We found that the standard curve could be extended to cover a wider range of choline concentrations and defined a procedure for the use of Norit for samples in which the vitamin C content was high enough to interfere with the analysis. Recoveries of choline added to infant formula powders and to representative dietary supplement tablets, capsules, powdered drink mix, and wafer products were 85–114%. The use of Norit during the procedure did not affect the recovery of choline added to infant formula powders or to dietary supplements. An alkaline digestion was included for use with a product containing lecithin as the sole source of choline. Ten of 11 dietary supplement products analyzed by the modified method contained amounts of choline at or above declarations found on the product labels. The remaining product contained about 40% of the label-declared amount of choline.

Choline, a dietary constituent, is an important component of membrane phospholipids. It provides a source of labile methyl groups, participates in transmembrane signaling, exerts a lipotropic action on the liver, is important for lipid and cholesterol transport and metabolism, and serves as a precursor for the neurotransmitter acetylcholine (1, 2). Choline is widely distributed in foods, with most of it in the form of phosphatidylcholine in membranes. Milk, liver, eggs, and peanuts are rich in choline.

Choline is also available as a dietary supplement of choline chloride or choline bitartrate and as lecithin, which usually contains about 25% phosphatidylcholine or 3–4% choline by weight. Foods and dietary supplements may now carry nutrient content claims, including claims about choline content, as authorized under the U.S. Food and Drug Administration Modernization Act (3).

Relatively few methods for the analysis of choline appear in the literature. Recently published methods report the use of proton nuclear magnetic resonance spectroscopy (4), liquid chromatography/electrospray ionization-isotope dilution mass spectrometry (5), and choline biosensors (6) for the quantitation of choline and its metabolites in several matrices. Instrumentation requirements of some of these methods may put them out of the reach of laboratories needing rapid and routine analyses for choline in foods and dietary supplements.

We studied the recently adopted AOAC Official Method 999.14 (Choline in Infant Formula and Milk—Enzymatic Colorimetric Method; 7, 8) to determine its applicability to the analysis of choline in matrices such as dietary supplements that may bear choline content claims. We used standard reference material (SRM) 1846 (Infant Formula), which has a noncertified reference value for choline, as an in-house quality assurance/quality control (QA/QC) material. We analyzed 5 infant formula powders and 11 dietary supplements of different types.

Experimental

Principle

The test sample is digested in acid (or, if needed, alkali) at 70°C, thereby releasing most of the choline. Following pH adjustment, treatment of hydrolysates with Norit (Fisher Scientific Co., Fairland, NJ) is included if needed to reduce interference from vitamin C. Residual choline phospholipids are then cleaved with phospholipase D, and the free choline moiety is subjected to choline oxidase with subsequent liberation of hydrogen peroxide. In the presence of peroxidase, phenol is oxidized and a quinoneimine chromophore is formed with 4-aminoantipyrine. Both enzymatic and color-forming reactions are formatted to occur concurrently. Absorbance is measured at 505 nm and choline

Aoac Methods For Dairy Products

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adopt the textbook **Enzymes Beyond Traditional Applications in Dairy Science and Technology** Y.S. Rajput, Rajan Sharma, 2023-01-26 A volume in the series on Foundations and Frontiers of Enzymology Enzymes Beyond Traditional Applications in Dairy Science and Technology presents the applications of enzymes in dairy science and technology Broken into four sections this book provides a brief account of traditional applications of indigenous milk enzymes the actions of exogenous enzymes on milk proteins for generating bioactive peptides and lactose for value addition and methods and approaches for ensuring milk quality or cleaning milk plants This book is an excellent resource for postgraduate students academics food scientists and dairy professionals engaged in milk processing Provides coverage on in vitro generation and in silico prediction of bioactive peptides by action of proteolytic enzymes on major milk proteins and peptides generated during fermentation and cheese manufacturing and their downstream processing Presents the enzymatic conversion of lactose into galactooligosaccharides or tagatose or producing low lactose milk Discusses indigenous enzymes in normal and mastitis milk Covers regulatory policies on enzyme use in food science Analytical Chemistry of PCBs Mitchell D. Erickson, 2018-05-11 This updated and expanded Second Edition of Dr Erickson s Analytical Chemistry of PCBs appears a decade after the first and is completely revised and updated The changes from the First Edition reflect the significant growth in the area and a growing appreciation of the importance of PCB analysis to our culture This book is a comprehensive review of the analytical chemistry of PCBs It is part history part annotated bibliography part comparison and part guidance Featuring a new chapter on analyst customer interactions and several new appendices the Second Edition is an invaluable resource for both chemists with no experience in PCB analysis and seasoned PCB researchers All topics have been more thoroughly treated and updated in this new edition to reflect advances made in the last decade especially

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mont saint michel wikipedia - Mar 18 2023

le mont saint michel baigne dans la baie du mont saint michel ouverte sur la manche l'îlot atteint 92 mètres d'altitude et offre une superficie émergée d'environ 7 ha la partie essentielle du rocher étant couverte par l'emprise au sol de l'abbaye du mont saint michel et de son domaine

le mont saint michel encyclopédie de l'histoire du monde - Oct 13 2022

oct 4 2018 l'île du mont saint michel est située à 1 km de la côte nord ouest de la france et elle est située à 66 km au nord de rennes et à 52 km à l'est de st malo le mont saint michel couvre une superficie de seulement 7 ha 17 acres et la circonférence de l'île couvre quelque 960 m tandis que son point le plus haut est 92 m au dessus du

tourisme à la découverte du mont saint michel des anglais - May 20 2023

jul 6 2023 france télévisions le saint michael s mount situé en cornouailles britannique est moins célèbre que le mont saint michel mais tout aussi spectaculaire il représente un château

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may 24 2023 les anglais tentent de prendre le mont sans succès une victoire qui donne au mont saint michel le titre de défenseur du royaume mais ces attaques laissent des traces en 1421 le chœur roman de l'église s'effondre le mont saint michel devenu la bastille des mers

st michael s mount une île en cornouailles la terre est un jardin - Jun 09 2022

un mini mont saint michel st michael s mount se situe à l'extrême sud de la péninsule de cornouailles face à la petite station balnéaire de marazion et proche de penzance ce mont saint michel anglais ressemble à s'y méprendre à

visiter st michael s mount le mont saint michel de l'angleterre - Sep 12 2022

st michael s mount est situé dans la région de cornwall complètement au sud ouest de l'angleterre c'est une région côtière magnifique avec de nombreux attraits où l'on peut facilement passer plus d'une semaine l'île se situe juste en face du charmant petit village de marazion la grande ville de penzance n'est distante que de 5 kilomètres

le mont saint michel wikipedia - Apr 19 2023

le mont saint michel note 1 est une commune française située dans la manche en normandie elle tire son nom de l'îlot rocheux consacré à saint michel où s'élève aujourd'hui l'abbaye du mont saint michel

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mont saint michel l abbaye du mont saint michel france est positionnée sur l axe 64 au nord cette direction fait face au lever du soleil du 8th mai traditionnellement le jour de printemps saint michel la direction opposée montre le coucher du soleil du 6th august transfiguration of christ mont saint michel france

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accessible à marée basse par la chaussée et à marée haute par bateau saint michael s mount situé sur un petit bout d île à deux pas de la côte abrite une chapelle xie siècle un

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mont saint michel wikipedia - Sep 24 2023

mont saint michel french pronunciation lə mɔ̃ sɛ miʃɛl norman mont saint miché english saint michael s mount is a tidal island and mainland commune in normandy france the island 4 lies approximately one kilometre one half nautical mile off france s north western coast at the mouth of the couesnon river near avranches