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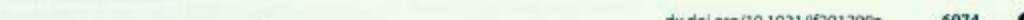
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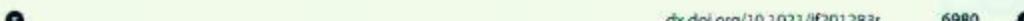
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[dx.doi.org/10.1021/jf200461j](https://doi.org/10.1021/jf200461j)**Anticancer Activities of Thelephantin O and Vialinin A Isolated from *Thelephora aurantiotincta***

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dx.doi.org/10.1021/jf200986k

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dx.doi.org/10.1021/jf200838f

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dx.doi.org/10.1021/jf201335g

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Accumulation and Distribution Pattern of Macro- and Microelements and Trace Elements in *Vitis vinifera* L. cv. Chardonnay Berries  
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Mechanism of Resistance to ACCase-Inhibiting Herbicides in Wild Oat (*Avena fatua*) from Latin America

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Investigation of Sulfonamide, Tetracycline, and Quinolone Antibiotics in Vegetable Farmland Soil in the Pearl River Delta Area, Southern China

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Photodegradation of the Herbicide Imazethapyr in Aqueous Solution: Effects of Wavelength, pH, and Natural Organic Matter (NOM) and Analysis of Photoproducts

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Adsorption and Desorption Behavior of Metalaxyl in Intensively Cultivated Acid Soils

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Extreme Variability of Steroid Profiles in Cow Feces and Pig Slurries at the Regional Scale: Implications for the Use of Steroids to Specify Fecal Pollution Sources in Waters

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Simultaneous Monitoring of Gaseous CO<sub>2</sub> and Ethanol above Champagne Glasses via Micro-gas Chromatography (μGC)

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Structural Rearrangement of Ethanol-Denatured Soy Proteins by High Hydrostatic Pressure Treatment

Jin-Mei Wang, Xiao-Quan Yang,\* Shou-Wei Yin, Ye Zhang, Chuan-He Tang, Bian-Sheng Li, De-Bao Yuan, and Jian Guo

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Gajendra S. Naik and Purnima Kaul Tiku\*

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Lipid Stability and Antioxidant Profile of Microsomal Fraction of Broiler Meat Enriched with α-Lipoic Acid and α-Tocopherol Acetate

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[dx.doi.org/10.1021/jf201522b](https://doi.org/10.1021/jf201522b)

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**Effect of Antioxidants on Soy Oil Conjugated Linoleic Acid Production and Its Oxidative Stability**

Ramesh R. Yettella, Brooke Henbest, and Andrew Proctor\*

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**Starch Characterization and Ethanol Production of Sorghum**

Yongfeng Ai, Jelena Medic, Hongxin Jiang, Donghai Wang, and Jay-Jin Jane\*

[dx.doi.org/10.1021/jf2007584](https://doi.org/10.1021/jf2007584)**Molecular Nutrition**

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**Spray-Dried Zein Capsules with Coencapsulated Nisin and Thymol as Antimicrobial Delivery System for Enhanced Antilisterial Properties**

Dan Xiao, P. Michael Davidson, and Qixin Zhong\*

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**Uridine Diphosphate Glucuronosyltransferase Isoform-Dependent Regiospecificity of Glucuronidation of Flavonoids**

Rashim Singh, Baojian Wu, Lan Tang, and Ming Hu\*

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**Calf Thymus DNA-Binding Ability Study of Anthocyanins from Purple Sweet Potatoes (*Ipomoea batatas* L.)**

Dan Wang, Xirui Wang, Chao Zhang, Yue Ma, and Xiaoyan Zhao\*

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7465

**Bioavailability of Iron from Wheat Aegilops Derivatives Selected for High Grain Iron and Protein Contents**

Rajani Salunke, Kumari Neelam, Nidhi Rawat, Vijay Kumar Tiwari, Harcharan Singh Dhaliwal, and Partha Roy\*

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**Impact of Glutathione on the Formation of Methylmethine- and Carboxymethine-Bridged (+)-Catechin Dimers in a Model Wine System**

Francesca Sonni, Evan G. Moore, Andrew C. Clark,\* Fabio Chinnici, Claudio Riponi, and Geoffrey R. Scollary

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**Anti-inflammatory Activities of Mogrosides from *Momordica grosvenori* in Murine Macrophages and a Murine Ear Edema Model**

Rong Di,\* Mou-Tuan Huang, and Chi-Tang Ho

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**Production of 8-Prenylnaringenin from Isoxanthohumol through Biotransformation by Fungi Cells**

Ming-liang Fu, Wei Wang, Feng Chen, Ya-chen Dong, Xiao-jie Liu, Hui Ni, and Qi-he Chen\*

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**Beneficial Effects of Dietary Fish-Oil-Derived Monounsaturated Fatty Acids on Metabolic Syndrome Risk Factors and Insulin Resistance in Mice**

Zhi-Hong Yang,\* Hiroko Miyahara, Tetsu Mori, Nobuhige Dolsaki, and Akimasa Hatanaka

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**Perchlorate in Soybean Sprouts (*Glycine max* L. Merr.), Water Dropwort (*Oenanthe stolonifera* DC.), and Lotus (*Nelumbo nucifera* Gaertn.) Root in South Korea**

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Sole-Dependent Lipid Content of Bovine Milk Fat Globule and Membrane Phospholipids

Ronit Mesilati-Stahy, Kfir Mida, and Nurit Argov-Argaman\*

**Levels of Perfluorinated Compounds in Food and Dietary Intake of PFOS and PFOA in The Netherlands**

Cornelle W. Noorlander,\* Stefan P. J. van Leeuwen, Jan Dirk te Biesebeek, Marcel J. B. Mengelers, and Marco J. Zeilmaker

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**Comparative Studies on the Interaction of Genistein, 8-Chlorogenistein, and 3',8-Dichlorogenistein with Bovine Serum Albumin**

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**Incidence of Fumonisin B<sub>2</sub> Production by *Aspergillus niger* in Portuguese Wine Regions**

Luis Abrunhosa,\* Thalita Calado, and Armando Venâncio

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**Gas Chromatographic Determination of N-Nitrosamines, Aromatic Amines, and Melamine in Milk and Dairy Products Using an Automatic Solid-Phase Extraction System**

Beatriz Jurado-Sánchez, Evaristo Ballesteros,\* and Mercedes Gallego\*

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**Efficacy of a Mycotoxin Binder against Dietary Fumonisin, Deoxynivalenol, and Zearalenone in Rats**

Zhiyi Qiang, My Truong, Koen Meynen, Patricia A. Murphy, and Suzanne Hendrich\*

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**Pharmacological, Structural, and Drug Delivery Properties and Applications of 1,3- $\beta$ -Glucans**

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**ABSTRACT:** 1,3- $\beta$ -Glucans are a class of natural polysaccharides with unique pharmacological properties and the ability to form single- and triple-helical structures that can be formed into resilient gels with the application of heat and humidity. The pharmacological capabilities of 1,3- $\beta$ -glucans include the impartation of tumor inhibition, resistance to infectious disease, and improvements in wound healing. Curdlan is a linear 1,3- $\beta$ -glucan that has been used extensively to study the nature of these helical structures and gels, and Curdlan sulfates have found ongoing application in the inhibition of HIV infection. 1,3- $\beta$ -Glucan gels have been used in food science as stabilizers and encapsulating agents, in nanoscience as scaffolds to build nanofibers and nanowires, and in drug delivery to form nanoparticles and create helical micelles encapsulating polynucleotides. 1,3- $\beta$ -Glucans are beginning to have enormous significance due to their dual nature as structure-forming agents and pharmacological substances, and research is especially focused on the application of these polymers in animal nutrition and drug delivery.

**KEYWORDS:** 1,3- $\beta$ -glucans, Curdlan, schizophyllan, helix, freeze-thaw, antitumor, infection, nanostructure, nanoparticle, drug delivery, polynucleotide

**INTRODUCTION**

**1,3- $\beta$ -Glucans.** Natural polysaccharides are an abundantly available resource from which to obtain unique properties applicable to a wide variety of industries. Cellulose is perhaps the most well-known example, with uses in paper manufacturing, membrane technology, textiles, and numerous food applications, and its nanocrystalline form is being used in high-strength polymer composites and novel bandage materials to speed wound healing.<sup>1</sup> Other notable examples are starch, xanthan, and others that are regularly used as freeze-thaw stabilizers, thickeners, and gelation agents in food science,<sup>2</sup> chitosan from shrimp shells with mucoadhesive properties that can facilitate ocular drug delivery,<sup>3,4</sup> and alginates from kelp that form hydrogels suitable as scaffolds for model extracellular matrices<sup>5</sup> or protein delivery vehicles that avoid protein denaturation during gelation.<sup>6</sup>

1,3- $\beta$ -Glucans are a class of glucopyranose polysaccharides with (1,3) glycosidic linkages (Figure 1) and varying degrees of (1,6) branching obtained from fungal<sup>7</sup> or microbial sources.<sup>8</sup> An illustration of the fungal cell wall adapted from electron micrographs of *Candida albicans*<sup>9</sup> demonstrates the natural presence of  $\beta$ -glucans in fungi (Figure 2). 1,3- $\beta$ -Glucans form helical structures that may be prompted to gel with the addition of heat and have a unique ability to increase host immunocompetency. Reported pharmacological effects include antitumor activity,<sup>10–12</sup> infection resistance,<sup>13,14</sup> cholesterol reduction,<sup>15,16</sup> and wound healing.<sup>17–19</sup>

The formation of 1,3- $\beta$ -glucan helical domains may be utilized for many applications or, provided the polysaccharide concentration is high enough, allowed to continue to the formation of a macroscopic gel. The gelation profile is dependent on the degree of branching due to the effect of C(6) branching on helix

packing.<sup>20</sup> Curdlan, a linear 1,3- $\beta$ -glucan, has been a good model for the study of 1,3- $\beta$ -glucan helical structures as it lacks the interference of periodic branching.<sup>21,22</sup> Because the exact properties such as gelation profiles, solubility, and degrees of branching differ so drastically among the family of 1,3- $\beta$ -glucans, discussion of the physical properties of these polysaccharides will follow the microbial 1,3- $\beta$ -glucan Curdlan as a model. Subsequent discussion of applications will focus on the general family of 1,3- $\beta$ -glucans. The unique properties of 1,3- $\beta$ -glucans have led to a variety of applications including the formulation of food gels for consumption or to improve stability and nutrition,<sup>23,24</sup> direct therapeutic application,<sup>25,26</sup> encapsulation and controlled release of various bioactive species,<sup>27,28</sup> and application as helical scaffolds for nanostructure formation.<sup>29,30</sup>

**PHYSICAL PROPERTIES OF CURDLAN 1,3- $\beta$ -GLUCANS**

**Overview.** Curdlan was first discovered as a resilient gel-forming polysaccharide bearing  $\beta$ -glycosidic linkages that was biosynthesized from the soil bacterium *Alcaligenes faecalis* var. *myxogenes* in the mid-1960s.<sup>31,32</sup> Curdlan was found to be a linear 1,3- $\beta$ -glucan that was insoluble in water but soluble in alkaline solutions. Experimentation with the gelation characteristics of Curdlan began shortly afterward.<sup>33,34</sup> Alkaline solutions inhibit hydrogen bonding between C(2) hydroxyls, inhibiting helix formation and leaving the random coil state. Commercial alkaline treatment leaves most available Curdlan powder <30% crystalline with a prevalence of a mixture of random coils and some

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