

Paul Bennett Savage

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Department of Chemistry and Biochemistry

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Education**University of Wisconsin**

Madison, Wisconsin

Doctor of Philosophy, Organic Chemistry, Biotechnology Minor, **1993**

Brigham Young University

Provo, Utah

Bachelor of Science, Chemistry, **1988**

Experience**University of Wisconsin**

Madison, Wisconsin

Research Assistant, **1988 - 1993**

Advisor - Dr. Samuel H. Gellman

The Ohio State University

Columbus, Ohio

NIH Postdoctoral Fellow, **1993 - 1995**

Advisor - Dr. Leo A. Paquette

Brigham Young University

Provo, Utah

Assistant Professor, **1995 - 2000**

Associate Professor, **2000 - 2004**

Professor, **2004 - 2005**

Associate Chair, **2004 - 2010**

Reed M. Izatt Professor of Chemistry and Biochemistry, **2005 - present**

University Professor, **2020 - present**

Research Emphases: Development of non-peptide mimics of antimicrobial peptides and carbohydrate-based vaccines adjuvanted with a natural killer T cell antigen for generation of high-affinity antibodies targeting bacterial glycans.

Awards

- Karl G. Maeser Distinguished Faculty Lecturer, **2021**
- Reed M. Izatt and James J. Christensen Faculty Excellence in Research Award, **2010**
- Brigham Young University Sponsored Research Award, **2008**
- Brigham Young University Karl G. Maeser Research and Creative Arts Award, **2006**
- Stoel Rives Utah Innovation Award, Biotechnology, **2006**
- Brigham Young University Technology Transfer Award, **2005**
- Brigham Young University Karl G. Maeser Excellence in Teaching Award, **2004**
- Brigham Young University Creative Works Award, **2001**
- Brigham Young University Young Scholar Award, **2000**
- College of Physical and Mathematical Sciences Award for Excellence in Teaching, **1999**
- National Science Foundation CAREER Award, **1998 - 2002**
- Student Award for Excellence in Teaching-Department of Chemistry, **1997, 1998**
- National Institutes of Health Postdoctoral Fellowship, **1994 - 1995**
- National Research Service Award (Biotechnology Trainee), **1990 - 1993**

Publications (Authored and Coauthored)

278. Aljayyousi, N.; Irmak, E. T.; Karaca, E.; Özer, E. T.; Akgün, Ari, R.; Çinar, A. Y.; Bozkurt-Güzel, C.; Savage, P. B.; Osman, B. *J. Biomed. Mat. Res. Part A* **2026**, *114*, e70102. Ceragenin-loaded tri-layered skin substitute composed of natural and synthetic biopolymers for burn wound healing.
277. Luckiewicz, M.; Wnorowska, U.; Zakrzewska, M.; Blazejczyk, I.; Daniluk, T.; Kondziolka, W.; Savage, P. B.; Bucki, R.; Piktel, E. *Eur. J. Pharmacol.* **2026**, *1019*, 178727. Exploring the role of cathelicidin LL-37 and ceragenins in wound healing processes.
276. Aslantas, K.; Oz, C.; Taghizadehghalehjoughi, A.; Genc, S.; Erdogan, A. S.; Savage, P. B.; Adiguzel, M. *C. Folia Microbiologica* **2026**, in press. Comparative assessment of antibacterial, antifungal, and cytotoxic activities of ceragenins CSA-44 and CSA-131 against endodontic pathogens. PMID: 41452448
275. Kaliniak, S.; Deptula, P.; Spalek, J.; Sawieljew, M.; Chmielewska-Deptula, S.; Daniluk, T.; Lesiak, A.; Durnas, B.; Savage, P. B.; Piktel, E.; Bucki, R.; Okla S. *Pharmaceutics*, **2025**, *18*, 1. Ceragenins in combination with ivacaftor prevent the formation of biofilm by bacteria that cause rhinosinusitis. PMID: 41599109 PMCID: PMC12844776
274. Mankowska, A.; Paprocka, P.; Suprewicz, L.; Lesaik, A.; Fortunka, K.; Krol, G.; Spalek, J.; Okla, S.; Durnas, B.; Daniluk, T.; Piktel, E.; Savage, P. B.; Bucki, R. *Frontiers Immunol.* **2025**, *16*, 1640392. Bactericidal activity of ceragenin CSA-13, CSA-44 and CSA-131 against bacteria causing bloodstream infections. PMID: 41103757 PMCID: PMC12521100
273. Bijak, P.; Piktel, E.; Niklinska, W.; Daniluk, T.; Paprocka, P.; Krol, G.; Savage, P. B.; Bucki, R. *Nanomedicine* **2025**, *20*, 2523-2543. Biological properties of ceragenin-coated metal nanoparticles – future challenges and perspectives in clinical practice. PMID: 40891129 PMCID: PMC12505520
272. Puertas-Segura, Peréz, L. M.; Savage, P. B.; Ivanova, K.; Giardelli, G.; Tzanov, T. *Nanoscale Adv.* **2025**, *7*, 5658-5669. Bottom-up sono-enzymatic approach to build antimicrobial and antifouling nano-enabled coatings on urinary catheters. PMID: 40801046 PMCID: PMC12336851
271. Puertas-Segura, A.; Lagana, A.; Rathee, G.; Savage, P. B.; Todorova, K.; Dimitrov, P.; Pashkuleva, I.; Reis, R. L.; Ciardelli, G.; Tzanov, T. *ACS Appl. Mater. Interfaces* **2025**, *17*, 44319-44332. Ceragenin nanogel coating prevents biofilms formation on urinary catheters. PMID: 40694658 PMCID: PMC12332827
270. Drake, S.; M.; Potter, C. D.; Zaugg, A. L.; Lumogdang, M. N.; Pendleton, D. J. Orchard, J. R.; Savage, P. B.; Patterson, J. E. *Discover Applied Sciences* **2025**, *7*, 785. Insights into the chemical basis for the impact of ceragenin and derivative compounds on the mechanical performance of medical adhesive formulations.
269. Aljayyousi, N.; Irmak, E. T.; Ozer, E. T.; Cinar, A. Y.; Guzel, C. B.; Savage, P. B.; Osman, B. *J. Applied Polymer Sci.* **2025**, *142*, e57129. Preparation, characterization and antimicrobial activities of ceragenins incorporated into polyvinyl alcohol/gelatin/sodium alginate-based hydrogels for treatment of burn wounds.
268. Gubler, S.; Zaugg, A.; Yi, R.; Sherren, E.; Milner, E.; Conyer, W.; May, T.; Jack, T.; Heaton, T.; Christopherson, J.; Higbee, P.; Powers, E.; Takara, M.; Linder, A.; Boyack, B.; Pauga, F.; Salmon, M.; Thomas, M.; Shiraki, M.; Deng, S.; Savage, P. B. *RCS Med. Chem.* **2025**, *16*, 1425-1440. Design, synthesis, antimicrobial activity, stability, and mechanism of action of bioresorbable ceragenins. PMID: 39897390 PMCID: PMC11782991
267. Taylor, S. A.; White, K.; Patton, R.; Linder, A.; Shin, S.; Nelson, S.; Haymore, J.; Zambrano, J.; Hayden, M.; Gubler, S.; Meng, T.; Finn, M. G.; Teyton, L.; Deng, S.; Savage, P. B. *J. Carb. Chem.* **2024**, *42*, 268-293. Syntheses of propargyl glycosides of disaccharides of the capsular polysaccharides from serotypes 4, 7F, and 9V *Streptococcus pneumoniae* for glycoconjugate vaccines. PMID: 39619385 PMCID: PMC11606575
266. Wnorowska, U.; Piktel, E.; Daniluk, T.; Paprocka, P.; Savage, P. B.; Durnas, B.; Bucki, R. *Pharmaceutics* **2024**, *17*, 1445. Ceragenins prevent the development of murine vaginal infections caused by *Gardnerella vaginalis*. PMID: 39598357 PMCID: PMC11597204
265. Czarnowski, M.; Wnorowska, U.; Luckiewicz, M.; Dargiewicz, E.; Spalek, J.; Oka, S.; Sawczuk, B.; Savage, P. B.; Bucki, R.; Piktel, E. *Pharmaceutics* **2024**, *17*, 1725. Natural antimicrobial peptides and their synthetic analogues for effective oral microflora control and oral infection treatment - the place of ceragenins in the development of new therapeutic methods. PMID: 39770567 PMCID: PMC11678171

264. Zaugg, A.; Sherren, E.; Yi, R.; Farnsworth, A.; Pauga, F.; Linder, A.; Kelly, L.; Takara, M.; Hoather, M.; Stump, S.; Behunin, C.; Boyack, B.; Tolly, M.; Holland, K.; Salmon, M.; Deng, S.; Patterson, J. E.; Savage, P. B. *Antibiotics* **2024**, *13*, 1002. Incorporation of ceragenins into medical adhesives and adhesive scar tape to prevent microbial colonization common in healthcare-associated infections. PMID: 39596697 PMCID: PMC11591062
263. Miao, W.; Porter, D. F.; Li, Y.; Meservey, L. M.; Yang, Y.Y.; Ma, C.; Ferguson, I. D.; Tien, V. B.; Jack, T. M.; Ducoli, L.; Lopez-Pajares, V.; Tao, S.; Savage, P. B.; Wang, Y.; Khavari, P. A. *Nucleic Acids Res.* **2024**, *52*, 13577-13593. Glucose binds and activates NSUN2 to promote translation and epidermal differentiation. PMID: 39565212 PMCID: PMC11662651
262. Meng, T.; James, B.; Haymore, J.; Wang, R.; Gubler, S.; Taylor, S. A.; Finn, M. G.; Teyton, L.; Deng, S.; Savage, P. B. *Tetrahedron* **2024**, *165*, 134186. Synthesis of propargyl glycosides of *Streptococcus pneumoniae* serotypes 6A and 6B for glycoconjugate vaccines. PMID: 39280115 PMCID: PMC11391900
261. Karasinski, M.; Wnorowska, U.; Daniluk, T.; Deptula, P.; Luckiewicz, M.; Paprocka, P.; Durnas, B.; Sklodowski, K.; Sawczuk, B.; Savage, P. B.; Piktel, E.; Bucki, R. *Internat. J. Mol. Sci.* **2024**, *25*, 7036. Investigating the effectiveness of ceragenins against *Acinetobacter baumannii* to develop new antimicrobial and anti-adhesive strategies. PMID: 39000144 PMCID: PMC11241064
260. Constanzo, A.; Clarke, D.; Holt, M.; Sharma, S.; Nagy, K.; Tan, Z.; Kain, L.; Abe, B.; Luce, S.; Boitard, C.; Wyseure, T.; Mosnier, L. O.; Su, A. I.; Grimes, C.; Finn, M. G.; Savage, P. B.; Gottschalk, M.; Pettus, J.; Teyton, L. *J. Immunol.* **2024**, *212*, 1-11. Repositioning the early pathology of type 1 diabetes to the extrasplet vasculature. PMID: 38426888 PMCID: PMC10944819
259. Wnorowska, U.; Lysik, D.; Piktel, E.; Zakrzewska, M.; Okla, S.; Lesiak, A.; Spalek, J.; Mystkowska, J.; Savage, P. B.; Janmey, P.; Fiedoruk, K.; Bucki, R. *PLOS One* **2024**, *19*, e0298112. Ceragenin-mediated disruption of *Pseudomonas aeruginosa* biofilms. PMID: 38346040 PMCID: PMC10861078
258. Czarnowski, M.; Slowinska, M.; Sawieljew, M.; Wnorowska, U.; Kaniluk, T.; Krol, G.; Karasinski, M.; Okla, S.; Savage, P. B.; Piktel, E.; Bucki, R. *Pharmaceuticals* **2024**, *17*, 204. Efficacy of ceragenins in controlling the growth of oral micro-organisms: implications for oral hygiene management. PMID: 38399419 PMCID: PMC10893225
257. Hacioglu, M.; Yilmaz, F. N.; Oyardi, O.; Bozkurt-Guzel, Inan, N.; Savage, P. B.; Sibel, D. *Pharmaceuticals* **2023**, *16*, 1643. Antimicrobial activity of ceragenins against vancomycin-susceptible and -resistant *Enterococcus* spp. PMID: 38139770 PMCID: PMC10747769
256. Farnsworth, A. J.; Holland, K. M.; Zaugg, A. L.; Pauga, F.; Drake, S. M.; Savage, P. B.; Patterson, J. E. *SN Appl. Sci.* **2023**, *5*, 373. Enhanced shear strength of a medical adhesive due to an antimicrobial additive.
255. Slodowski, K.; Suprewicz, L.; Chmielewska-Deptula, S. J.; Kaliniak, S.; Okla, S.; Zakrzewska, M.; Minarows, L.; Mroz, R.; Daniluk, T.; Savage, P. B.; Fiedoruk, K.; Bucki, R. *Front. Microbiol.* **2023**, *14*, 1290952. Ceragenins exhibit bactericidal properties that are independent of the ionic strength in the environment mimicking cystic fibrosis sputum. PMID: 38045035 PMCID: PMC10693459
254. Zaugg, A.; Sherren, E.; Yi, R.; Larsen, T.; Dyck, B.; Stump, S.; Pauga, F.; Linder, A.; Takara, M.; Gardner, E.; Shin, S.; Pulsipher, J.; Savage, P. B. *Internat. J. Mol. Sci.* **2023**, *24*, 14923. Incorporating ceragenins into coatings protects peripherally inserted central catheter lines against pathogen colonization for multiple weeks. PMID: 37834369 PMCID: PMC10573620
253. Oyardi, O.; Demir, E. S.; Alkan, B.; Komec, S.; Genc, G. E.; Aygun, G.; Teke, L.; Turan, D.; Eturan, Z.; Savage, P. B.; Bozkurt-Güzel, C. *J. Fungi* **2023**, *9*, 9101026. Investigation of virulence factors, susceptibility to ceragenins, and the impact of biofilm formation on drug efficacy in *Candida auris* isolates from Türkiye. PMID: 37888282 PMCID: PMC10607835
252. Yilmaz, F. N.; Öksüz, L.; Demir, E. F.; Dösler, S.; Savage, P. B.; Bozkurt-Güzel, C. *Curr. Microbiol.* **2023**, *80*, 327. Efficacy of ceragenins alone and in combination with antibiotics against multidrug-resistant Gram-negative pathogens from bloodstream infections. PMID: 37620557
251. Suprewicz, L.; Szczepanski, A.; Lenart, M.; Piktel, E.; Fiedoruk, K.; Barreto-Duran, E.; Kula-Pacurar, A.; Savage, P. B.; Milewska, A.; Bucki, R.; Pryc, K. *Antiviral Res.* **2023**, *217*, 105676. Ceragenins exhibit antiviral activity against SARS-CoV-2 by increasing the expression and release of type I interferons upon activation of the host's immune response. PMID: 37481038

250. Prasad, S. V.; Fiedoruk, K.; Zakrzewska, M.; Savage, P. B.; Bucki, R. *Microbiol. Spectrum* **2023**, *11*, e01215-23. Glyoxylate shunt and pyruvate-to-acetoin shift are specific stress responses induced by colistin and ceragenin CSA-13 in *Enterobacter hormaechei* ST89. PMID: 37338344 PMCID: PMC10434160
249. Oyardi, O.; Eltimur, T.; Demir, E. S.; Alkan, B.; Savage, P. B.; Akcali, A.; Bozkurt-Guzel, C. *Curr. Microbiol.* **2023**, *80*, 210. Antibacterial and antibiofilm activities of ceragenins alone and in combination with levofloxacin against multidrug resistant *Myroides* spp. clinical isolates from patients with urinary tract infections. PMID: 37191731
248. Hodak, C. R.; Bescucci, D. M.; Shamash, K.; Kelly, L. C.; Montana, T.; Savage, P. B.; Inglis, G. D. *Animals* **2023**, *6*, 997. Antimicrobial growth promoters altered the function but not the structure of enteric bacterial communities in broiler chicks +/- microbiota transplantation. PMID: 36978538 PMCID: PMC10044420
247. Wnorowska, U.; Piktel, E.; Duptula, P.; Wollny, T.; Krol, G.; Gluszek, K.; Durnas, B.; Pogoda, K.; Savage, P. B.; Bucki, R. *Sci. Reports* **2022**, *12*, 19164. Ceragenin CSA-13 displays high antibacterial efficiency in a mouse model of urinary tract infection. PMID: 36357517 PMCID: PMC9649698
246. Dao, A.; McDonald, M. M.; Savage, P. B.; Little, D. G.; Schindeler, A. *J. Bone Oncol.* **2022**, *37*, 100460. Preventing osteolytic lesions and osteomyelitis in multiple myeloma. PMID: 36388641 PMCID: PMC9640986
245. Oyardi, O.; Savage, P. B.; Guzel, C. B. *Pathogens* **2022**, *11*, 1044. Effects of ceragenins and antimicrobial peptides on the A549 cell line and *in vitro* co-culture model of A549 cells and *Pseudomonas aeruginosa*. PMID: 36145476 PMCID: PMC9503685
244. Paprocka, P.; Mankowska, A.; Sklodowski, K.; Krol, G.; Wollny, T.; Lesaik, A.; Gluszek, K.; Savage, P. B.; Durnas, B.; Bucki, R. *Pathogens* **2022**, *11*, 621. Bactericidal activity of ceragenin in combination with ceftazidime, levofloxacin, co-trimoxazole, and colistin against the opportunistic pathogen *Stenotrophomonas maltophilia*. PMID: 35745475 PMCID: PMC9227598
243. Tokujuk, J.; Deptula, P.; Chmielewska, S. J.; Sklodowski, K.; Mierzejewska, Z. A.; Gradzka-Dahlke, M.; Tolstoj, A.; Daniluk, T.; Paprocka, P.; Savage, P. B.; Bucki, R. *Pathogens* **2022**, *11*, 491. Ceragenin CSA-44 as a means to control the formation of the biofilm on the surface of tooth and composite fillings. PMID: 35631012 PMCID: PMC9143991
242. Demir, E. S.; Oyardi, O.; Savage, P. B.; Altay, H. O.; Bozkurt-Guzel, C. *J. Antibiot.* **2022**, *75*, 403-409. In vitro activity of ceragenins against *Burkholderia cepacia* complex. PMID: 35562592
241. Mitchell, G.; Silvis, M. R.; Talkington, K. C.; Budzik, J. M.; Dodd, C. E.; Paluba, J. M.; Oki, E. A.; Trotta, K. L.; Licht, D. J.; Jimenez-Morales, D.; Chou, S.; Savage, P. B.; Gross, C. A.; Marletta, M. A.; Cox, J. S. *mBio* **2022**, *13*, e02726. Ceragenins and antimicrobial peptides kill bacteria through distinct mechanisms. PMID: 35073755 PMCID: PMC8787472
240. Paprocka, P.; Durnas, B.; Mankowska, A.; Sklodowski, K.; Krol, G.; Zakrzewska, M.; Czarnowski, M.; Kot, P.; Fortunka, K.; Gozdz, S.; Savage, P. B.; Bucki, R. *Infect. Drug Resist.* **2021**, *14*, 5681-5698. New β -lactam antibiotics and ceragenins - A study to assess their potential in treatment of infections caused by multidrug-resistant strains of *Pseudomonas aeruginosa*. PMID: 34992394 PMCID: PMC8715797
239. Prasad, S. V.; Piktel, E.; Depcuich, J.; Maximenko, A.; Suprewicz, L.; Daniluk, T.; Spalek, J.; Wnorowska, U.; Zielinski, P. M.; Parlinska-Wojtan, M.; Savage, P. B.; Olka, S.; Fiedoruk, K.; Bucki, R. *Nanomedicine* **2021**, *16*, 2657-2678. Targeting bacteria causing otitis media using nanosystems containing nonspherical gold nanoparticles and ceragenins. PMID: 34823374
238. Skłodowski, K.; Chmielewska, S. J.; Depciuch, J.; Deptuła, P.; Piktel, E.; Daniluk, T.; Zakrzewska, M.; Czarnowski, M.; Cieśluk, M.; Durnaś, B.; Parlinska-Wojtan, M.; Savage, P. B.; Bucki, R. *Pharmaceutics* **2021**, *13*, 1940. Ceragenin-coated non-spherical gold nanoparticles as novel candidacidal agents. PMID: 34834355 PMCID: PMC8619546
237. Piktel, E.; Ościłowska, I.; Łukasz Suprewicz, Ł.; Depciuch, J.; Marcińczyk, N.; Chabielska, E.; Wolak, P.; Głuszek, K.; Klimek, J.; Zieliński, P. M.; Marzec, M. T.; Savage, P. B.; Parlińska-Wojtan, M.; Bucki, R. *Cancers*, **2021**, *13*, 5424. Peanut-shaped gold nanoparticles with shell of ceragenin CSA-131 display ability to inhibit ovarian cancer growth in vitro and in a tumor xenograft model. PMID: 34771587 PMCID: PMC8582422

236. Spalek, J.; Daniluk, T.; Godlewski, A.; Deptuła, P.; Wnorowska, U.; Ziembicka, D.; Cieśluk, M.; Fiedoruk, K.; Ciborowski, M.; Krętowski, A.; Gózdź, S.; Durnaś, B.; Savage, P. B.; Okła, S.; Bucki, R. *Pathogens* **2021**, *10*, 1371. Assessment of ceragenins in prevention of damage to voice prostheses caused by *Candida* biofilm formation. PMID: 34832527 PMCID: PMC8622639
235. Kamble, S.; Valtchev, P.; Dao, A.; Pelras, T.; Rogers, M. J.; Savage, P. B.; Dehghani, F.; Schindeler, A. *Molecules* **2021**, *26*, 1541. Synthesis and characterization of bone binding antibiotic-1 (BBA-1), a novel antimicrobial for orthopedic applications. PMID: 33799713 PMCID: PMC7999004
234. Chmielewska, S. J.; Sklodowski, K.; Depciuch, J.; Deptuła, P.; Piktel, E.; Fiedoruk, K.; Kot, P.; Paprocka, P.; Fortunka, K.; Wollny, T.; Wolak, P.; Parlinska-Wojtan, M.; Savage, P. B.; Bucki, R. *Pharmaceutics* **2021**, *13*, 425. Bactericidal properties of rod-, peanut-, and star-shaped gold nanoparticles coated with ceragenin CSA-131 against multidrug-resistant bacterial strains. PMID: 33809901 PMCID: PMC8004255
233. Haynie, T.; Gubler, S.; Drees, C.; Heaton, T.; Mitton, T.; Gleave, Q.; Bendelac, A.; Deng, S.; Savage, P. B. *RCS Advances* **2021**, *11*, 14357-14361. Synthesis of the pentasaccharide repeating unit from *Ruminococcus gnavus* and measurement of its inflammatory properties. PMID: 35424013 PMCID: PMC8697740
232. Kirshbaum, C.; Greis, K.; Mucha, E.; Kain, S.; Deng, S.; Zappe, A.; Gewinner, S.; Schöllkopf W.; von Helden, G.; Meijer, G.; Savage, P. B.; Marianski, M.; Teyton, L.; Pagel, K. *Nat. Comm.* **2021**, *12*, 1201. Unravelling the structural complexity of glycolipids with cryogenic infrared spectroscopy. PMID: 33619275 PMCID: PMC7900115
231. Latorre, M. C.; Pérez-Granda, M. J.; Savage, P. G.; Alonso, B.; Martín-Rabadán, P.; Samaniego, R.; Bauzo, E.; Muñoz, P.; Guembe, M. *J. Antimicrob. Chemother.* **2021**, *76*, 1168-1173. Endotracheal tubes coated with a broad-spectrum antibacterial ceragenin reduce bacterial biofilm in an in vitro bench top model. PMID: 33544817
230. Oyardi, Ö, Savage, P. B.; Erturan, Z.; Bozkurt-Guzel, C. *J. Antimicrob. Chemother.* **2021**, *76*, 443-450. *In vitro* assessment of CSA-131 and CSA-131 poloxamer form for the treatment of *Stenotrophomonas maltophilia* infections in cystic fibrosis. PMID: 33094334
229. Choi, J.; Mele, T. S.; Porcelli, S. A.; Savage, P. B.; Haeryfar, S. M. M. *J. Immunol.* **2021**, *206*, 386-397. Harnessing the versatility of iNKT cells in a step-wise approach to sepsis immunotherapy. PMID: 33310870 PMCID: PMC7785635
228. Chmielewska, S. J.; Sklodowski, D.; Piktel, E.; Suprewicz, L.; Fiedoruk, K.; Daniluk, T.; Wolak, P.; Savage, P. B.; Bucki, R. *Infect. Drug Resist.* **2020**, *13*, 3277-3294. NDM-1 carbapenemase-producing *Enterobacteriaceae* are highly susceptible to ceragenins CSA-13, CSA-44, and CSA-131. PMID: 33061475 PMCID: PMC7535143
227. Damar-Celik, D.; Mataraci-Kara, E.; Savage, P. B.; Ozbek-Celik, B. *J. Chemother.* **2021**, *33*, 216-227. Antibacterial and antibiofilm activities of ceragenins against *Achromobacter* species isolated from cystic fibrosis patients. PMID: 32985386
226. Iweala, O. I.; Choudhary, S. K.; Addison, C. T.; Batty, C. J.; Kapita, C. M.; Amelio, C.; Schuyler, A.; Deng, S.; Bachelder, E. M.; Ainslei, K. M.; Savage, P. B.; Brennan, P. J.; Commings, S. P. *J. Allergy Clin Immunol.* **2020**, *146*, 450-452. Glycolipid-mediated basophil activation in alpha-gal allergy. PMID: 32088306 PMCID: PMC7670280
225. Piktel, E.; Markiewicz, K. H.; Wilczewska, A. Z.; Daniluk, T.; Chmielewska, S.; Niemorowicz-Laskowska, K.; Mystkowska, J.; Paprocka, P.; Savage, P. B.; Bucki R. *Int. J. Nanomed.* **2020**, *15*, 4573-4589. Quantification of synergistic effects of ceragenin CSA-131 combined with iron oxide magnetic nanoparticles against cancer cells. PMID: 32606693 PMCID: PMC7321689
224. Bozkurt Guzel, C.; Avci, N. M.; Savage, P. B. *Turkish J. Pharma. Sci.* **2020**, *17*, 63-67. *In vitro* activities of the cationic steroid antibiotics CSA-13, CSA-131, CSA-138, CSA-142, and CSA-192 against carbapenem-resistant *Pseudomonas aeruginosa*. PMID: 32454762 PMCID: PMC7227862
223. Alehashem, M. S.; Bin Ariffin, A.; Savage, P. B.; Dabdawb, W. A. Y.; Thomas, N. F. *RSC Adv.* **2020**, *10*, 10989-11012. Treasures old and new: what we can learn regarding the macrocyclic problem from past and present efforts in natural product total synthesis. PMID: 35495309 PMCID: PMC9050488

222. Bozkurt-Guzel, C.; Inci, G.; Oyardi, O.; Savage, P. B. *Curr. Microbiol.* **2020**, *77*, 1419-1428. Synergistic activity of ceragenins against carbapenem-resistant *Acinetobacter baumannii* strains in both checkerboard and dynamic time-kill assays. PMID: 32189050 PMCID: PMC7223130
221. Hacıoglu, M.; Oyardi, O.; Bozkurt-Guzel, C.; Savage, P. B. *J. Antibiotics* **2020**, *73*, 455-462. Antibiofilm activities of ceragenins and antimicrobial peptides against fungal-bacterial mono and multispecies biofilms. PMID: 32203127
220. Mills, R. J.; Boyling, A.; Cheng, T. L.; Peacock, L.; Savage, P. B.; Tagin, M.; Little, D. G.; Schindeler, A. *J. Orthopaedic Res.* **2020**, *38*, 2065-2073. CSA-90 reduces periprosthetic joint infection in a novel rat model challenged with local and systemic *Staphylococcus aureus*. PMID: 32009241
219. Dao, A.; Mills, R. J.; Kamble, S.; Savage, P. B.; Little, D. G.; Schindeler, A. *J. Orthopaedic Res.* **2020**, *38*, 1883-1894. The application of ceragenins to orthopedic surgery and medicine. PMID: 31994754
218. Iweala, O. I.; Choudhary, S. K.; Addison, C. T.; Batty, C. J.; Kapita, C. M.; Amelio, C. I.; Schuyler, A. J.; Deng, S.; Bachelder, E. M.; Ainslie, K. M.; Savage, P. B.; Brennan, P. J.; Commins, S. P. *J. Allergy Clin. Immunol.* **2020**, *146*, 450-452. Glycolipid-mediated basophil activation in alpha-gal allergy. PMID: 32088306 PMCID: PMC7670280
217. Wnorowska, U.; Fiedoruk, K.; Piktel, E.; Prasad, S. V.; Sulik, M.; Janion, M.; Daniluk, T.; Savage, P. B.; Bucki, R. *J. Nanobiotech.* **2020**, *18*, 3. Nanoantibiotics containing membrane-active human cathelicidin LL-37 or synthetic ceragenins attached to the surface of magnetic nanoparticles as novel and innovative therapeutic tools: current status and potential future applications. PMID: 31898542 PMCID: PMC6939332
216. Bozkurt-Guzel, C.; Hacıoglu, M.; Inci, G.; Savage, P. B. *Turkish J. Pharma. Sci.* **2019**, *16*, 444-449. Antibacterial and antibiofilm activities of ceragenins against *Pseudomonas aeruginosa* clinical isolates. PMID: 32454748 PMCID: PMC7227877
215. Ozbek-Celik, B.; Damar-Celik, D.; Mataraci-Kara, E.; Bozkurt-Guzel, C.; Savage, P. B. *Antibiotics* **2019**, *8*, 130. Comparative *in vitro* activities of first and second-generation ceragenins alone and in combination with antibiotics against multidrug-resistant *Klebsiella pneumoniae* strains. PMID: 31461867 PMCID: PMC6784107
214. Hacıoglu, M.; Haciosmanoglu, E.; Birteksoz-Tan, A. S.; Bozkurt-Guzel, C.; Savage, P. B. *Diag. Microbiol. Infect. Dis.* **2019**, *93*, 114863. Effects of ceragenins and conventional antimicrobials on *Candida albicans* and *Staphylococcus aureus* mono and multispecies biofilms. PMID: 31471074
213. Pereira, C.; Pérez-Cabezas, B.; Ribeiro, H.; Maia, L.; Cardoso, T.; Dias, A. F.; Azevedo, O.; Ferreira, F.; Garcia, P.; Rodrigues, E.; Chaves, P.; Martins, P.; Pineda, M.; Amraoui, Y.; Fecarotta, S.; Leão-Teles, E.; Deng, S.; Savage, P. B.; Macedo, F. *Front. Immunol.* **2019**, *10*, 1264. Lipid antigen presentation by CD1b and CD1d in lysosomal storage disease patients. PMID: 31214199 PMCID: PMC6558002
212. Ghosh, S.; Gabrielle, J.; Korza, G.; He, L.; Yuan, J.-H.; Dong, W.; Setlow, B.; Li, Y.-Q. Savage, P. B.; Setlow, P. *J. Appl. Microbiol.* **2019**, *127*, 109-120. Effects of the microbicide ceragenin CSA-13 on and properties of *Bacillus subtilis* spores prepared on two very different media. PMID: 31067345
211. Bandara, N.; Li, Y.; Diebold, P.; Mpoy, C.; Gu, X.; Khanal, P.; Deng, S.; Rogers, B. E.; Savage, P. B. *RCS Advances* **2019**, *9*, 14472-14476. Translation of ceragenin affinity for bacteria to an imaging reagent for infection. PMID: 32864109 PMCID: PMC7451630
210. Wnorowska, U.; Piktel, E.; Durnas, B.; Fiedoruk, K.; Savage, P. B.; Bucki, R. *BMC Infectious Diseases* **2019**, *19*, UNSP 369. Use of ceragenins as a potential treatment for urinary tract infections. PMID: 31046689 PMCID: PMC6498624
209. Birteksoz-Tan, A. S.; Zuhail, Z.; Hacıoglu, M.; Savage, P. B.; Bozkurt-Guzel, C. *J. Antibiotics* **2019**, *72*, 291-297. *In vitro* activities of antimicrobial peptides and ceragenins against *Legionella pneumophila*. PMID: 30755738
208. Durnás, B.; Fiedoruk, K.; Ciesluk, M.; Deptula, P.; Król, G.; Piktel, E.; Savage, P. B.; Bucki, R. *Med. Studies* **2019**, *35*, 1-9. Lysozyme increases bactericidal activity of ceragenin CSA-13 against *Bacillus subtilis*.
207. Teyton, L.; Finn M. G.; Savage, P. B.; Polonskaya, Z. *Curr. Opin. Immunol.* **2019**, *59*, 65-71. High-affinity anti-glycan antibodies: challenges and strategies. PMID: 31029911 PMCID: PMC6774850

206. Hashemi, M. M.; Holden, B. S.; Coburn, J.; Taylor, M. F.; Weber, S.; Hilton, B.; Zaugg, A. L.; McEwan, C.; Carson, R.; Anderson, J. L.; Price, J. C.; Deng, S.; Savage, P. B. *Frontiers Microbiol.* **2019**, *10*, 210. Proteomic analysis of resistance of Gram-negative bacteria to chlorhexidine and impacts on susceptibility to colistin, antimicrobial peptides and ceragenins. PMID: 30833936 PMCID: PMC6388577
205. Chuang, Y.-T.; Leung, K.; Chang, Y.-J.; DeKruyff, R. H.; Savage, P. B.; Cruse, R.; Benoit, C.; Elewaut, D.; Baumbarth, N.; Umetsu, D. T. *J. Allergy Clin. Immunol.* **2019**, *143*, 565-576. A natural killer T-cell subset that protects against airway hyperreactivity. PMID: 29852257
204. Hacıoglu, M.; Bozkurt-Guzel, C. B.; Savage, P. B.; Tan, A. S. B. *Med. Mycol.* **2019**, *57*, 291-299. Antifungal susceptibilities, in vitro production of virulence factors and activities of ceragenins against *Candida* spp. isolated from vulvovaginal candidiasis. PMID: 29846682
203. Bozkurt-Gozel, C.; Oyardi, O.; Savage, P. B. *J. Chemother.* **2018**, *30*, 332-227. Comparative *in vitro* antimicrobial activities of CSA-142 and CSA-192, second-generation ceragenins, with CSA-13 against various microorganisms. PMID: 30663553
202. Piktel, E.; Prokop, I.; Wnorowska, U.; Krol, G.; Ciesluk, M.; Niemirowicz, K.; Savage, P. B.; Bucki R. *Oncotarget* **2018**, *9*, 21904-21920. Ceragenin CSA-13 as free molecules and attached to magnetic nanoparticle surfaces induce caspase-dependent apoptosis in human breast cancer cells via disruption of cell oxidative balance. PMID: 29774111 PMCID: PMC5955147
201. Hashemi, M. M.; Mmuoegbulam, A. O.; Holden, B. S.; Coburn, J.; Wilson, J.; Taylor, M. F.; Reiley, J.; Baradaran, D.; Stenquist, T.; Deng, S.; Savage, P. B. *Internat. J. Environ. Res. Public Health* **2018**, *15*, 2758. Susceptibility of multidrug-resistant bacteria, isolated from water and plants in Nigeria, to ceragenins. PMID: 30563216 PMCID: PMC6313750
200. Schmid, H.; Schneidawind, C.; Jahnke, S.; Kettermann, F.; Secker K.-A.; Duerr-Stoerzer, S.; Keppeler, H.; Kanz, L.; Savage, P. B.; Scheidawind, D. *Frontiers Immunol.* **2018**, *9*, 1817. Culture-expanded human invariant natural killer T cells suppress T-cell alloreactivity and eradicate leukemia. PMID: 30127790 PMCID: PMC6088196
199. Bozkurt-Gozel, C.; Hacıoclu, M.; Savage, P. B. *Diag. Microbiol. Infect. Dis.* **2018**, *91*, 324-330. Investigation of the in vitro antifungal and antibiofilm activities of ceragenins CSA-8, CSA-13, CSA-44, CSA-131 and CSA-138 against *Candida* species. PMID: 29680320
198. Mills, R.; Cheng, T. L.; Mikulec, K.; Peacock, L.; Isaacs, D.; Genberg, C.; Savage, P. B.; Little, D. G.; Schindeler, A. *Clin. Orthoped. Rel. Res.* **2018**, *476*, 1311-1323. CSA-90 promotes bone formation and mitigates methicillin-resistant *Staphylococcus aureus* infection in a rat open fracture model. PMID: 29698291 PMCID: PMC6263573
197. Hashemi, M. M.; Holden, B. S.; Taylor, M. F.; Wilson, J.; Coburn, J.; Hilton, B.; Nance, T.; Gubler, S.; Genberg, C.; Deng, S.; Savage, P. B. *Molecules* **2018**, *23*, 596. Antibacterial and antifungal activities of poloxamer micelles containing ceragenin CSA-131 on ciliated tissues. PMID: 29518893 PMCID: PMC6017798
196. Bucki, R.; Durnás, B.; Watek, M.; Piktel, W.; Cruz, K.; Wolak, P.; Savage, P. B.; Janmey, P. A. *Infect. Drug Resist.* **2018**, *11*, 77-86. Targeting polyelectrolyte networks in purulent body fluids to modulate bactericidal properties of some antibiotics. PMID: 29391814 PMCID: PMC5768182
195. Hashemi, M. M.; Rovig, J.; Bateman, J.; Holden, B. S.; Modzelewski, T.; Gueorguieva, I.; von Dyck, M.; Bracken, R.; Genberg, C.; Deng, S.; Savage, P. B. *J. Antimicrob. Chemother.* **2018**, *73*, 143-150. Preclinical testing of a broad-spectrum antimicrobial endotracheal tube coated with an innate immune synthetic mimic. PMID: 29029265 PMCID: PMC5890737
194. Hashemi, M. M.; Rovig, J.; Holden, B. S.; Taylor, M. F.; Weber, S.; Wilson, J.; Hilton, B.; Zaugg, A. L.; Ellis, S. W.; Yost, C. D.; Finnegan, P. M.; Kistler, C. K.; Berkow, E. L.; Deng, S.; Lockhart, S. R.; Peterson, M.; Savage, P. B. *J. Antimicrob. Chemother.* **2018**, *73*, 1537-1545. Ceragenins are active against drug-resistant *Candida auris* clinical isolates in planktonic and biofilm forms. PMID: 29635279
193. Piktel, E.; Pogoda, K.; Savage, P. B.; Bucki, R. *Future Microbiol.* **2017**, *12*, 735-737. The search for new sporicidal agents for medical use: where are we? PMID: 28593804

192. Niemirowicz, K.; Durnás, B.; Tokajuk, G.; Piktel, E.; Michalak, G.; Gu, X.; Kulakowska, A.; Savage, P. B.; Bucki, R. *Sci. Reports* **2017**, *7*, 4610. Formulation and candidacidal activity of magnetic nanoparticles coated with cathelicidin LL-37 and ceragenin CSA-13. PMID: 28747178 PMCID: PMC5530502
191. Durnás, B.; Piktel, E.; Watek, M.; Wollny, T.; Gózd, S.; Smok-Kalwat, J.; Niemirowicz, K.; Savage, P. B.; Bucki, R. *BMC Microbiol.* **2017**, *17*, 167. Anaerobic bacteria growth in the presence of cathelicidin LL-37 and selected ceragenins delivered as magnetic nanoparticles cargo.
190. Pogoda, K.; Piktel, E.; Deptula, P.; Savage, P. B.; Lekka, M.; Bucki, R. *Micron* **2017**, *101*, 95-102. Stiffening of bacterial cells of first manifestation of bactericidal attack. PMID: 28683405
189. Hashemi, M. M.; Rovig, J.; Weber, S.; Hilton, B.; Forouzan, M. M.; Savage, P. B. *Antimicrob. Agents Chemother.* **2017**, *61*, e00292-17. Susceptibility of colistin-resistant, Gram-negative bacteria to antimicrobial peptides and ceragenins. PMID: 28584137 PMCID: PMC5527650
188. Hashemi, M. M.; Holden, B. S.; Durnás, B.; Bucki, R.; Savage, P. B. *J. Antimicrob. Agents* **2017**, *3*, 141. Ceragenins as mimics of endogenous antimicrobial peptides.
187. Olekson, M. A.; Tao, Y.; Savage, P. B.; Leung, K. P. *FEBS Open Bio* **2017**, *7*, 953-967. Ceragenin peptide-mimics inhibit biofilms and affect mammalian cell bioability and migration *in vitro*. PMID: 28680809 PMCID: PMC5494304
186. Piktel, E.; Pogoda, K.; Roman, M.; Niemirowicz, K.; Tokajuk, G.; Wróblewska, M.; Szynaka, B.; Savage, P. B.; Bucki, R. *Sci. Reports* **2017**, *7*, 44452. Sporocidal activity of ceragenin CSA-13 against *Bacillus subtilis*. PMID: 28294162 PMCID: PMC5353641
185. Polonskaya, Z.; Deng, S.; Sarka, A.; Kain, L.; Comellas-Aragones, M.; McKay, C.; Kaczanowska, K.; Holt, M.; McBride, R.; Palomo, V.; Self, K.; Taylor, S.; Irimia, A.; Mehta, S. R.; Dan, J. M.; Brigger, M.; Crotty, S.; Schoenberger, S. P.; Paulson, J. C.; Wilson, I. A.; Savage, P. B.; Finn, M. G.; Teyton, L. *J. Clin. Invest.* **2017**, *127*, 1491-1504. T cells control the generation of nanomolar-affinity anti-glycan antibodies. PMID: 28287405 PMCID: PMC5373877
184. Deng, S.; Kain, L.; Pereira, C. S.; Mata, S.; Macedo, M. F.; Bendelac, A.; Teyton, L.; Savage, P. B. *Chem. Sci.* **2017**, *8*, 2204-2208. Psychosine variants as antigens for natural killer T cells. PMID: 28507675 PMCID: PMC5408565
183. Tleugabulova, M. C.; Escalante, N. K.; Deng, S.; Fieve, S.; Erono-Orbea, J.; Savage, P. B.; Julien, J. P.; Mallevaey, T. *J. Immunol.* **2016**, *197*, 3959-3969. Discrete TCR binding kinetics control invariant NKT cell selection and central priming. PMID: 27798168
182. Li, B.; Suita, M.; Bright, V.; Koktysh, D.; Matlock, B. K.; Dumas, M. E.; Zhu, M. Y.; Holt, A.; Stec, D.; Deng, S.; Savage, P. B.; Joyce, S.; Pham, W. *Int. J. Nanomed.* **2016**, *11*, 6103-6121. Improved proliferation of antigen-specific cytolytic T lymphocytes using a multimodal nanovaccine. PMID: 27895483 PMCID: PMC5117944
181. Niemirowicz, K.; Piktel, E.; Wilczewska, A. Z.; Markiewicz, K. H.; Durnás, B.; Watek, M.; Puszkarz, I.; Wróblewska, M.; Niklińska, W.; Savage, P. B.; Bucki, R. *Int. J. Nanomed.* **2016**, *11*, 5443-5455. Core-shell magnetic nanoparticles display synergistic antibacterial effects against *Pseudomonas aeruginosa* and *Staphylococcus aureus* when combined with cathelicidin LL-37 or selected ceragenins. PMID: 27799768 PMCID: PMC5077129
180. Vartabedian, V. F.; Savage, P. B.; Teyton, L. *Immunol. Rev.* **2016**, *272*, 109-119. The processing and presentation of lipids and glycolipids to the immune system. PMID: 27319346 PMCID: PMC4916853
179. Durnas, B.; Wnorowska, U.; Pogoda, K.; Deptula, P.; Watek, M.; Piktel, E.; Gluszek, S.; Gu, X.; Savage, P. B.; Niemirowicz, K.; Bucki, R. *Plos One* **2016**, *11*, e0157242. Candidacidal activity of selected ceragenins and human cathelicidin LL-37 in experimental settings mimicking infections sites. PMID: 27315208 PMCID: PMC4912103
178. Polat, Z. A.; Cetin, A.; Savage, P. B. *Acta Parasitol.* **2016**, *61*, 367-381. Evaluation of the *in vitro* activity of ceragenins against *Trichomonas vaginalis*. PMID: 27078662
177. Bucki, R.; Niemirowicz, K.; Wnorowska, U.; Byfield, F. J.; Piktel, E.; Watek, M.; Janmey, P. A.; Savage, P. B. *Antimicrob. Agents Chemother.* **2015**, 6274-6282. Bactericidal activity of ceragenin CSA-13 in cell culture and in an animal model of peritoneal infection. PMID: 26248361 PMCID: PMC4576122

176. Paletta, D.; Fichtner, A. S.; Starick, L.; Porcelli, S. A.; Savage, P. B.; Herrmann, T. *Plos One* **2015**, *10*, e0143449. Species specific differences of CD1d oligomer loading *in vitro*. PMID: 26599805 PMCID: PMC4657966
175. Vila-Farrés, X.; Callarisa, A. E.; Gu, X.; Savage, P. B.; Giral, E.; Vila J. *Internat. J. Antimicrob. Agents* **2015**, *46*, 568-571. CSA-131, a ceragenin active against colistin-resistant *Acinetobacter baumannii* and *Pseudomonas aeruginosa* clinical isolates. PMID: 26395218
174. Niemirowicz, K.; Prokop, I.; Wilczewska, A. Z.; Wnorowska, U.; Piktel, E.; Watek, M.; Savage, P. B.; Bucki, R. *Int. J. Nanomedicine* **2015**, *10*, 3843-3853. Magnetic nanoparticles enhance the anticancer activity of cathelicidin LL-37 peptide against colon cancer cells. PMID: 26082634 PMCID: PMC4461127
173. Kain, L.; Constanzo, A.; Webb, B.; Holt, M.; Bendelac, A.; Savage P. B.; Teyton, L. *Molecular Immunol.* **2015**, *68*, 94-97. Endogenous ligands of natural killer T cells are alpha-linked glycosylceramides. PMID: 26141240 PMCID: PMC4624034
172. Hina, S.; Rajoka, M. I.; Savage, P. B.; Roohi, S.; Bokhari, T. H. *Bulg. Chem. Comm.* **2015**, *47*, 747-754. Labeling, quality control and biological evaluation of ^{99m}Tc-vibramycin for infection sites imaging.
171. Niemirowicz, K.; Sural, U.; Wilczewska, A. Z.; Mystkowska, J.; Piktel, E.; Gu, X.; Namiot, Z.; Kulakowska, A.; Savage, P. B.; Bucki, R. *J. Nanobiotech.* **2015**, *13*, 32. Bactericidal activity and biocompatibility of ceragenin-coated magnetic nanoparticles. PMID: 25929281 PMCID: PMC4458011
170. Wnorowska, U.; Niemirowicz, K.; Myint, M.; Daimond, S.; Wróblewska, M.; Savage, P. B.; Janmey, P.; Bucki, R. *Antimicrob. Agents Chemother.* **2015**, *59*, 3808-3815. Bactericidal activity of cathelicidin LL-37 and select cationic lipids against the hypervirulent *P. aeruginosa* strain LESB58. PMID: 25870055 PMCID: PMC4468669
169. Hoppens, M. A.; Sylvester, C. B.; Qureshi, A. T.; Scherr, T.; Czaps, D. R.; Duran, R. S.; Savage, P. B.; Hayes, D. *ACS App. Mat. Interfaces* **2014**, *6*, 13900-13908. Ceragenin mediated selectively of antimicrobial silver nanoparticles.
168. Kain, L.; Webb, B.; Anderson, B. L.; Deng, S.; Holt, M.; Castanzo, A.; Zhao, M.; Self, K.; Teyton, A.; Everett, C.; Kronenberg, M.; Zajonc, D. M.; Bendelac, A.; Savage, P. B. Teyton, L. *Immunity* **2014**, *41*, 543-554. The identification of the endogenous ligands of natural killer T cells reveals the existence of mammalian alpha-linked glycosylceramides.
167. Nitchau, J.; Crabé, S.; Orlandini, B.; Nell, H.; Grygar, C.; Bellier, F.; Racouet, F.; Bendelac, A.; Deng, S.; Savage, P. B.; Teyton, L.; Serra, V. *Vaccine* **2014**, *32*, 6138-6145. Efficacy of ABX196, a new NKT agonist, in prophylactic human vaccination.
166. Bozkurk-Guzel, C.; Savage, P. B.; Akcali, A.; Ozbek-Celik, B. *Biomed Res. Internat.* **2014**, Article # 710273. Potential synergy activity of the novel ceragenin, CSA-13, against carbapenem-resistant *Acinetobacter baumannii* strains isolated from bacteremia patients.
165. Deng, S.; Bai, L.; Reboulet, R.; Mathew, R.; Teyton, L.; Bendelac, A.; Savage, P. B. *Chem. Sci.* **2014**, *5*, 1437-1441. A peptide-free, liposome-based oligosaccharide vaccine, adjuvanted with a natural killer T cell antigen, generates robust antibody responses *in vivo*. PMCID: 3966715.
164. Hoppens, M. A.; Wheeler, Z. E. W.; Qureshi, A. T.; Hogan, K.; Wright, A.; Stanley, G. G.; Young, D.; Savage, P. B.; Hayes, D. *J. Coll. Interface Sci.* **2014**, *413*, 167-174. Maghemite, silver, ceragenin conjugate particles for selective binding and contrast of bacteria.
163. Anderson, B. L.; Teyton, L.; Bendelac, A.; Savage, P. B. *Molecules* **2013**, *18*, 15662-15688. Stimulation of natural killer T cells by glycolipids.
162. Luoma, A. M.; Castro, C. D.; Mayassi, T.; Brembinster, L. A.; Bai, L.; Picard, D.; Anderson, B.; Scharf, L.; Kung, J. E.; Sibener, L. B.; Savage, P. B.; Jabri, B.; Bendelac, A.; Adams, E. J. *Immunity* **2013**, *39*, 1032-1042. Crystal structure of Vδ1 T cell receptor in complex with CD1d-sulfatide shows MHC-like recognition of a self-lipid by human γδ T cells.
161. Chaudhary, V.; Albacker, L. A.; Deng, S.; Chuang, Y.-T.; Umetsu, D. T.; Savage, P. B. *Org. Lett.* **2013**, *15*, 5242-5245. Synthesis of fungal glycolipid asperamide B and investigation of its ability to stimulate natural killer T cells.
160. Bai, L.; Deng, S.; Reboulet, R.; Mathew, R.; Teyton, L.; Savage, P. B.; Bendelac, A. *Proc. Nat'l Acad. Sci. USA*, **2013**, *110*, 16097-16102. NKT-B cell interactions promote prolonged antibody responses and long-

term memory to pneumococcal capsular polysaccharides.

159. Gu, X.; Jennings, J. D.; Snarr, J.; Chaudhary, V.; Pollard, J. E.; Savage, P. B. *Invest. Ophthalmol. & Vis. Sci.* **2013**, *54*, 6217-6223. Optimization of ceragenins for prevention of bacterial colonization of hydrogel contact lenses.
158. Kuroda, K.; Fukuda, T.; Okumura, K.; Yoneyama, H.; Isogai, H.; Savage, P. B.; Isogai, E. *Anti-Cancer Drugs* **2013**, *24*, 826-834. Ceragenin CSA-13 induces cell cycle arrest and antiproliferative effects in wild-type and p53 null mutant HCT116 colon cancer cells.
157. Albacker, L. A.; Chaudary, V.; Chang, Y.-J.; Kim, H. Y.; Chuang, Y.-T.; Pichuvant, M.; DeKruyff, R. H.; Savage, P. B.; Umetsu, D. T. *Nature Medicine* **2013**, *19*, 1297-1304. A fungal glycosphingolipid directly activates natural killer T cells and rapidly induces airway disease.
156. Kim, H. Y.; Chang, Y.-J.; Chuang, T.-T.; Lee, H.-H.; Kasahara, D. I.; Martin, T.; Hsu, J. T.; Savage, P. B.; Shore, S. A.; Freeman, G. J.; DeKruyff, R. H.; Umetsu, D. T. *J. Allergy Clin. Immunol.* **2013**, *132*, 414-425. T-cell immunoglobulin and mucin domain 1 deficiency eliminates airway hyperreactivity triggered by the recognition of airway cell death.
155. Nagant, C.; Pitts, B.; Stewart, P. S.; Feng, Y.; Savage, P. B.; Dehaye, J.-P. *Microbiol. Open* **2013**, *2*, 318-325. Study of the effect of antimicrobial peptide mimic, CSA-13, on an established biofilm formed by *Pseudomonas aeruginosa*.
154. Zahoor, R.; Roohi, S.; Ahmad, M.; Iqbal, Z.; Amir, N.; Tariq, S.; Savage, P. B. *J. Radioanal. Nucl. Chem.* **2013**, *295*, 841-844. Synthesis of ^{99m}Tc-cationic steroid antimicrobial-107 and in vitro evaluation.
153. Leszczynska, K.; Namiot, D.; Byfield, F.; Zendzian-Piotrowska, M.; Fein, D.; Savage, P. B.; Diamond, S.; McCulloch, C.; Jamney, P.; Bucki, R. *J. Antimicrob. Chemother.* **2013**, *68*, 610-618. Antibacterial activity of the human host defense peptide LL-37 and selected synthetic cationic lipids against bacteria associated with oral and upper respiratory tract infections.
152. López-Sagasetta, J.; Kung, J. E.; Savage, P. B.; Gumperz, J.; Adams, E. J. *PLoS Biol.* **2012**, *10*, 10.1371. The molecular basis for recognition of CD1d/α-galactosylceramide by a human non-Vα24 T cell receptor.
151. Freigang, S.; Landais, E.; Zadorozhny, V.; Yoshida, K.; Liu, Y.; Deng, S.; Palinksi, W.; Savage, P. B.; Bendelac, A.; Teyton, L. *J. Clin. Invest.* **2012**, *122*, 3943-3954. Scavenger receptor-mediated uptake controls the bioactivity of the prototypic NKT cell agonist α-galactosylceramide *in vivo*.
150. Williams, D. L.; Haymond, B. S.; Beck, J. P.; Savage, P. B.; Chaudary, V.; Epperson, R. T.; Kawaguchi, B.; Bloebaum, R. D. *Biomaterials* **2012**, *33*, 8641-8656. *In vivo* efficacy of a silicone-cationic steroid antimicrobial coating to prevent implant-related infection.
149. Pollard, J. E.; Snarr, J.; Chaudhary, V.; Jennings, J. D.; Shaw, H.; Geiss, B.; Wright, J.; Jia, W.; Bishop, R. E.; Savage, P. B. *J. Antimicrob. Chemother.* **2012**, *67*, 2665-2672. *In vitro* evaluation of the potential for resistance development to ceragenin CSA-13. PMID: PMC3468081
148. Bai, L.; Picard, D.; Anderson, B.; Chaudhary, V.; Luoma, A.; Jabri, B.; Adams, E. J.; Savage, P. B.; Bendelac, A. *Eur. J. Immunol.* **2012**, *42*, 2505-2510. The majority of CD1d-sulfatide specific T cells in human blood use a semi-invariant Vδ1 TCR.
147. Nagant, C.; Savage, P. B.; Dehaye, J. P. *J. Appl. Microbiol.* **2012**, *112*, 1173-1183. Effect of pluronic acid F-127 on the toxicity towards eukaryotic cells of CSA-13, a cationic steroid analogue of antimicrobial peptides.
146. Kim, H. Y.; Chang, Y.-J.; Subramanian, S.; Lee, H.-H.; Albacker, L. A.; Matangkasombut, P.; Savage, P. B.; McKenzie, A. N. J.; Smith, D. E.; Rottman, J. B.; DeKruyff, R. H.; Umetsu, D. T. *J. Allergy Clin. Immunol.* **2012**, *129*, 216-U319. Innate lymphoid cells responding to IL-33 mediate airway-hyperreactivity independent of adaptive immunity.
145. Pereira, R. L.; Reis, V. O.; Semedo, P.; Buscariollo, B. N.; Donizzeti-Oliveira, C.; Cenedeze, M. A.; Pacheco-Silva, A.; Savage, P. B.; Camara, N. O. S.; Keller, A. C. *PLoS One* **2012**, *7*, 10.1371. Invariant natural killer T cell agonist modulates experimental focal and segmental glomerulosclerosis.
144. Bozkurt-Güzel, Ç.; Savage, P. B.; Gerçeker, A. A. *Chemotherapy* **2011**, *57*, 505-510. In vitro activities of the novel ceragenin CSA-13, alone or in combination with colistin, tobramycin and ciprofloxacin against *Pseudomonas aeruginosa* strains isolated from cystic fibrosis patients.

143. Bai, L.; Constantinides, M. G.; Thomas, S. Y.; Reboulet, R.; Meng, F.; Krentgen, F.; Teyton, L.; Savage, P. B.; Bendelac, A. *J. Immunol.* **2012**, *188*, 3053-3061. Distinct antigen-presenting cells explain the cytokine bias of α -galactosylceramide variant *in vivo*.
142. Scanlon, S.; Thomas, S.; Ferreira, C. M.; Bai, L.; Krausz, T.; Savage, P. B.; Bendelac, A. *J. Exp. Med.* **2011**, *208*, 2113-2124. Airborne lipid antigens mobilize resident intravascular NKT cells to induce allergic airway inflammation.
141. Smith, P. A.; Jackson-Lepage, C. R.; Savage, P. B.; Bowerbank, C. R.; Lee, E. D.; Lukacs, M. J. *Anal. Chim. Acta* **2011**, *690*, 215-220. Use of a hand-portable gas chromatograph-toroidal ion trap mass spectrometer for self-chemical ionization identification of degradation products related to O-ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (VX).
140. Deng, S.; Mattner, J.; Zang, Z.; Bai, L.; Teyton, L.; Bendelac, A.; Savage, P. B. *Org. Biomol. Chem.* **2011**, *9*, 7659-7662. Impact of sugar stereochemistry on natural killer T cell stimulation by bacterial glycolipids.
139. Nagant, C.; Feng, Y.; Lucas, B.; Braeckmans, K.; Savage, P. B.; Dehaye, J.-P. *J. Appl. Microbiol.* **2011**, *111*, 763-772. Effect of a low concentration of a cationic steroid antibiotic (CSA-13) on the formation of a biofilm by *Pseudomonas aeruginosa*.
138. Mohammed, J. P.; Fusakio, M. E.; Rainbow, D. B.; Moule, C.; Fraser, H. I.; Clark, J.; Todd, J. A.; Peterson, L. B.; Savage, P. B.; Wills-Karp, M.; Ridgway, W. M.; Wicker, L. S.; Mattner, J. *J. Immunol.* **2011**, *187*, 337-349. Identification of Cd101 as a susceptibility gene for *Novosphingobium aromaticivorans*-induced liver autoimmunity.
137. Blumenfeld, H. J.; Tohn, R.; Haeryfar, S. M. M.; Liu, Y.; Savage, P. B.; Delovitch, T. L. *Clin. Exp. Immunol.* **2011**, *166*, 121-133. Structure-guided design of an iNKT cell agonist for optimum protection from type 1 diabetes in NOD mice.
136. Chang, Y. J.; Kim, H. Y.; Albacker, L. A.; Lee, H. H.; Baumgarth, N.; Akira, S.; Savage, P. B.; Endo, S.; Yamamura, T.; Maaskant, J.; Kitano, N.; Singh, A.; Bhatt, A.; Besra, G. S.; van den Elzen, P.; Appelmek, B.; Franck, R. W.; Chen, G. W.; DeKruyff, R. H.; Shimamura, M.; Illarionov, P.; Umetsu, D. T. *J. Clin. Invest.* **2011**, *121*, 57-69. Influenza infection in suckling mice expands an NKT cell subset that protects against airway hyperreactivity.
135. Polat, Z. A.; Savage, P. B.; Genberg, C. G. *J. Ocular Pharmacol. Therapeutics* **2011**, *21*, 1-5. *In vitro* amoebicidal activity of a ceragenin, CSA-13, against *Acanthamoeba castellanii* and its cytotoxic potential.
134. Trainor, E. A.; Horton, K. E.; Savage, P. B.; Testerman, T. L.; McGee, D. J. *Infect. Immun.* **2011**, *79*, 88-97. The role of the HefC efflux pump in *Helicobacter pylori* cholesterol-dependent resistance to ceragenins and bile salts.
133. Leszczynska, K.; Namiot, A.; Cruz, K.; Byfield, F. J.; Won, E.; Mendez, G. Wojciech, S.; Savage, P. B.; Bucki, R.; Janmey, P. A. *J. Appl. Microbiol.* **2011**, *110*, 229-238. Potential of ceragenin CSA-13 and its mixture with pluronic F-127 as treatment for topical bacterial infections.
132. Byfield, F. J.; Kowalski, M.; Cruz, K.; Leszczynska, K.; Namiot, A.; Savage, P. B.; Bucki, R.; Janmey, P. A. *J. Immunol.* **2011**, *187*, 6402-6409. Cathelicidin LL-37 increases lung epithelial cell stiffness, decreases transepithelial permeability, and prevents epithelial invasion by *Pseudomonas aeruginosa*.
131. Braun, N. A.; Mendez-Fernandez, Y. V.; Covarrubias, R.; Porcelli, S. A.; Savage, P. B.; Yagita, H.; Van Kaer, L.; Major, A. S. *Arteriosclerosis Thrombosis Vasc. Biol.* **2010**, *30*, 1758-U178. Development of spontaneous anergy in invariant natural killer T cells in a mouse model of dyslipidemia.
130. Epand, R. F.; Pollard, J. E.; Wright, J. O.; Savage, P. B.; Epand, R. M. *Antimicrob. Agents Chemother.* **2010**, *54*, 3708-3717. Depolarization, bacterial membrane composition and the antimicrobial action of ceragenins. PMID: PMC2934994
129. Smith, P. A.; Lepage, C. J.; Lukacs, M.; Martin, N.; Shufutinsky, A.; Savage, P. B. *Int. J. Mass Spectrom.* **2010**, *295*, 113-118. Field-portable gas chromatography with transmission quadrupole and cylindrical ion trap mass spectrometric detection: chromatographic retention index data and ion/molecule interactions for chemical warfare agent identification.
128. Semmling, V.; Lukacs-Kornek, V.; Thaiss, C. A.; Quast, T.; Hochheiser, K.; Panzer, U.; Rossjohn, J.; Perlmutter, P.; Cao, J.; Godfrey, D. I.; Savage, P. B.; Knolle, P. A.; Kolanus, W.; Förster, I.; Kurts, C. *Nature Immunol.* **2010**, *11*, 313-U57. Alternative cross-priming through CCL17/CCR4-mediated CTL

attraction towards NKT cell-licensed dendritic cells.

127. Bucki, R.; Leszczynska, K.; Byfield, F. J.; Fein, D. E.; Won, E.; Cruz, K.; Namiot, A.; Kulakowska, A.; Namiot, Z.; Savage, P. B.; Diamond, S.; Janmey, P. A. *Antimicrob. Agents Chemother.* **2010**, *54*, 2525-2533. Combined antibacterial and anti-inflammatory activity in a cationic disubstituted dexamethasone spermine conjugate (D2S).
126. Lee, H.-H.; Meyer, E. H.; Goya, S.; Pichavant, M.; Kim, H. Y.; Umetsu, S. E.; Jones, J. C.; Savage, P. B.; Casasnovas, J. M.; Kaplan, G.; Freeman, G. J.; DeKruyff, R. H.; Umetsu, D. T. *J. Immunology* **2010**, *185*, 522-5235. Apoptotic cells activate NKT cells through Ig-like mucin-like-1 resulting in airway hyperreactivity.
125. Lara, D.; Feng, Y.; Bader, J.; Savage, P. B.; Maldonado, R. A. *J. Parasitol.* **2010**, *96*, 638-642. Anti-trypansomatid activity of ceragenins.
124. Monine, M. I.; Posner, R. G.; Savage, P. B.; Faeder, J. R.; Hlavacek, W. S. *Biophys. J.* **2010**, *95*, 48-56. Modeling multivalent ligand-receptor interactions with steric constraints on configurations of cell-surface receptor aggregates.
123. Freigang, S.; Zadorozhny, V.; McKinney, M.; Krebs, P.; Schrantz, N.; Masuda, K.; Liu, Y.; Savage, P. B.; Bendelac, A.; Cravatt, B. F.; Teyton, L. *J. Clin. Invest.* **2010**, *120*, 1873-1884. Fatty acid amide hydrolyase shapes NKT cell responses by regulating the serum transport of lipid antigen.
122. Pollard, J.; Wright, J.; Feng, Y.; Geng, D.; Genberg, C.; Savage, P. B. *Anti-Infectives in Medicinal Chemistry* **2009**, *8*, 290-294. Activities of ceragenin CSA-13 against established biofilms in an *in vitro* model of catheter decolonization.
121. Leszczynska, K.; Namiot, A.; Fein, D. E.; Wen, Q.; Namiot, Z.; Savage, P. B.; Diamond, S.; Janmey, P. A.; Bucki, R. Bactericidal activities of the cationic steroid CSA-13 and the cathelicidin peptide LL-37 against *Helicobacter pylori* in simulated gastric juice. *BMC Microbiol.* **2009**, *9*, 187.
120. Morshed, S. R.; Takahashi, T.; Savage, P. B.; Kambham, N.; Strober, S. *Clin. Immunol.* **2009**, *132*, 321-333. β -galactosylceramide alters invariant natural killer T cell function and is an effective treatment for lupus.
119. Howell, M. D.; Streib, J. E.; Kim B. E.; Lesley, L.; Dunlap, A.; Geng, D.; Savage, P. B.; Leung, D. Y. M. *J. Invest. Dermatol.* **2009**, *129*, 2668-2675. Ceragenins: a new class of anti-viral compounds to treat orthopox infections.
118. Yin, N.; Long, X.; Goff, R. D.; Zhou, D.; Cantu, C.; Mattner, J.; Saint Mezard, P.; Teyton, L.; Bendelac, L.; Savage, P. B. *ACS Chem. Biol.* **2009**, *4*, 191-197. Alpha anomers of iGb3 and Gb3 stimulate cytokine production by natural killer T cells. PMID: PMC2843501
117. Kim, H. Y.; Pichavant, M.; Matangkasombut, P.; Koh, Y. I., Savage, P. B.; DeKruyff R. H.; Umetsu, D. T. *J. Immunol.* **2009**, *182*, 3252-3261. The development of airway hyperreactivity in T-bet-deficient mice requires CD1d-restricted NKT cells.
116. Bai, L.; Sagiv, Y.; Liu Y.; Freigang, S.; Yu, K. A. O.; Teyton, L.; Porcelli, S. A.; Savage, P. B.; Bendelac, A. *Proc. Natl Acad. Sci.* **2009**, *106*, 10254-10259. Lysosomal recycling terminates CD1d-mediated presentation of short and polyunsaturated variants of the NKT cell lipid antigen α GalCer.
115. Roohi, S.; Amir, N.; Ahmed, M.; Savage, P. B.; Saluhiddin, S. M.; Jehangir, M. *J. Radioanal. Nuclear Chem.* **2009**, *97*, 57-62. Synthesis, quality control and biological evaluation of ^{99m}Tc labeled CSA-13.
114. Farruggia, G.; Iotti, S.; Prodi, L.; Zaccheroni, N.; Montalti, M.; Savage, P. B.; Andreani, G.; Trapani, V.; Wolf, F. I. *J. Fluorescence* **2009**, *19*, 11-19. A simple spectrofluorometric assay to measure total intracellular magnesium by a hydroxyquinoline derivative.
113. Isogai, E.; Isogai, H.; Takahashi, K.; Okumura, K.; Savage, P. B. *Oral Microbiol. Immunol.* **2009**, *24*, 170-172. Ceragenin CSA13 exhibits antimicrobial activity against cariogenic and periodontopathic bacteria.
112. Epand, R. M.; Epand, R. F.; Savage, P. B. *Drug News Perspect.* **2008**, *21*, 307-311. Ceragenins (cationic steroid compounds), a novel class of antimicrobial agents.
111. Saha, S.; Savage, P. B.; Bal M. *J. Appl. Microbiol.* **2008**, *105*, 822-828. Enhancement of the efficacy of erythromycin in multiple antibiotic-resistant gram-negative bacterial pathogens.

110. Koh, Y. I.; Kim, H. Y.; Meyer, E. H.; Pichavant, M.; Akabri, O.; Yasumi, T.; Savage, P. B.; DeKruyff, R. H.; Umetsu, D. T. *J. Immunol.* **2008**, *181*, 4560-4569. Activation of nonclassical CD1d restricted natural killer T cells induces airway hyperreactivity in β 2-microglobulin deficient mice.
109. Lai, X.-Z.; Feng, Y.; Pollard, J.; Chin, J. N.; Rybak, M. J.; Bucki, R.; Epand, R. F.; Epand, R. M.; Savage, P. B. *Acc. Chem. Res.* **2008**, *41*, 1233-1240. Ceragenins: cholic acid-based mimics of antimicrobial peptides.
108. Pichavant, M.; Goya, S.; Meyer, E. H.; Johnston, R. A.; Kim, H. Y.; Matagkasombut, P.; Zhu, M.; Iwakura, Y.; Savage, P. B.; DeKruyff, R. H.; Shore, S. A.; Umetsu, D. T. *J. Exp. Med.* **2008**, *205*, 385-393. Ozone exposure in a mouse model induces airway hyperreactivity that requires the presence of natural killer T cells and IL-17.
107. Mattner, J.; Savage, P. B.; Leung, P.; Oertelt, S. S.; Wang, V.; Trivedi, O.; Scanlon, S. T.; Teyton, L.; Hart, J.; Ridgway, W. M.; Wicker, L. S.; Gershwin, E. M.; Bendelac, A. *Cell Host Microbe* **2008**, *3*, 304-315. Liver autoimmunity triggered by microbial activation of NKT cells.
106. Matangkasombut, P.; Pichavant, M.; Yasumi, T.; Hendricks, C.; Savage, P. B.; DeKruyff, R. H.; Umetsu, D. T. *J. Allergy Clin. Immunol.* **2008**, *121*, 1287-1289. Direct activation of natural killer T cells induces airway hyperreactivity in nonhuman primates.
105. Fuangswasdi, S.; Kaveevivitchai, N.; Tuntulani, T.; Savage, P. B. *J. Solution Chem.* **2008**, *37*, 45-58. Complexing properties of phenolic diazacrown ethers with transition and heavy metal ions.
104. Zajonc, D.; Savage, P. B.; Bendelac, A.; Wilson, I.; Teyton, L. *J. Mol. Biol.* **2008**, *377*, 1104-1116. Crystal structures of mouse CD1d-iGb3 complex and its cognate V α 14 T cell receptor suggest a model for dual recognition of foreign and self glycolipids.
103. Bucki, R.; Namiot, D. B.; Namiot, Z.; Savage, P. B.; Janmey, P. A. *J. Antimicrob. Chemother.* **2008**, *62*, 329-335. Salivary mucins inhibit antibacterial activity of cathelicidin-derived LL-37 peptide but not the cationic steroid CSA-13.
102. Savage, P. B.; Nielsen, J.; Lai, X.-Z.; Feng, Y.; Li, Y.; Nelson, G.; Linford, M. R.; Genberg, C. Antibacterial activities of thin films containing ceragenins. In Camesano, T.A. and Mello, C. (Eds.). *Microbial Surfaces: Structure, Interactions and Reactivity*. ACS Symposium Series 984, Washington, D.C.: American Chemical Society, **2008**, 65-78.
101. Liu, Y.; Deng, S.; Bai, L.; Freigang, S.; Mattner, J.; Teyton, L.; Bendelac, A.; Savage, P. B. *Bioorg. Med. Chem. Lett.* **2008**, *18*, 3052-3055. Synthesis of diglycosylceramides and evaluation of their iNKT cell stimulatory properties. PMID: PMC2846726
100. Chin, J. N.; Jones, R. N.; Sader, H. S.; Savage, P. B.; Rybak, M. J. *J. Antimicrob. Chemother.* **2008**, *61*, 365-370. Potential synergy activity of the novel ceragenin, CSA-13 against clinical isolates of *Pseudomonas aeruginosa*, including multi-drug resistant *P. aeruginosa*.
99. Posner, R. G.; Geng, D.; Haymore, S.; Bogert, J.; Pecht, I.; Licht, A.; Savage, P. B. *Org. Lett.* **2007**, *9*, 3551-3554. Trivalent antigens for degranulation of mast cells.
98. Long, X.; Deng, S.; Zang, Z.; Mattner, J.; Zhou, D.; McNary, N.; Goff, R. D.; Teyton, L.; Bendelac, A.; Savage, P. B. *Nature Chem. Biol.* **2007**, *3*, 559-564. Synthesis and evaluation of stimulatory properties of *Sphingomonadaceae* glycolipids.
97. Epand, R. F.; Savage, P. B.; Epand, R. M. *Biochim. Biophys. Acta* **2007**, *1768*, 2500-2509. Bacterial lipid composition and the antimicrobial efficacy of cationic steroid compounds (ceragenins).
96. Sagiv, Y.; Bai, L.; Wei, D. G.; Agami, R.; Savage, P. B.; Teyton, L.; Bendelac, A. *J. Exp. Med.* **2007**, *204*, 921-928. A distal effect of microsomal triglyceride transfer protein deficiency on the lysosomal recycling of CD1d.
95. Michel, M.-L.; Keller, A. C.; Paget, C.; Fujio, M.; Trottein, F.; Savage, P. B.; Wong, C. H.; Schneider, E.; Dy, M.; Liete de Moraes, M. *J. Exp. Med.* **2007**, *204*, 995-1001. Identification of a new IL-17-producing iNKT cell subset involved in airway neutrophilia.
94. Meyer, E. H.; Wurbel, M. A.; Staton, T. L.; Pichavant, M.; Savage, P. B.; Kan, M. J.; DeKruyff, R.; Butcher, E. C.; Campbell, J. J.; Umetsu, D. *Immunity* **2007**, *179*, 4661-4671. iNKT cells require CCR4 to localize to the airways and to induce airway-hyperreactivity.
93. Chin, J. N.; Rybak, M. J.; Cheung, C. M.; Savage, P. B. *Antimicrob. Agents Chemother.* **2007**, *51*, 1268-1273. Antimicrobial activity of novel ceragenins against clinical isolates of resistant *Staphylococcus aureus*.

92. Bendelac, A.; Savage, P. B.; Teyton, L. *Annu. Rev. Immunol.* **2007**, *25*, 297-336. Biology of NKT cells.
91. Schrantz, N.; Sagiv, Y.; Liu, Y.; Savage, P. B.; Bendelac, Teyton, L. *J. Exp. Med.* **2007**, *204*, 841-852. The Niemann-Pick Type C2 protein loads isoglobotrihexosylceramide onto CD1d molecules and contributes to the thymic selection of NKT cells.
90. Bucki, R.; Sostarecz, A. G.; Byfield, F. J.; Savage, P. B.; Janmey, P. A. *J. Antimicrob. Chemother.* **2007**, *60*, 535-545. Resistance of the antibacterial agent ceragenin CSA-13 to inactivation by DNA of F-actin, and its activity in cystic fibrosis sputum.
89. Savage, P. B.; Bendelac, A.; Teyton, L. *Chem. Soc. Rev.* **2006**, *35*, 771-779. Glycolipids for natural killer T cells.
88. Sagiv, Y.; Hudspeth, K.; Mattner, J.; Schrantz, N.; Stern, R. K.; Zhou, D.; Savage, P. B.; Teyton, L.; Bendelac, A. *J. Immunol.* **2006**, *177*, 26-30. Cutting edge: Impaired glycosphingolipids trafficking and NKT cell development in mice lacking Niemann-Pick Type C1 protein.
87. Campos-Martín, Y.; Colmenares, M.; Gozalbo-López, B.; López-Núñez, M.; Savage, P. B.; Martínez-Naves, E. *J. Immunol.* **2006**, *176*, 6172-6179. Immature human dendritic cells infected with *Lieshmania infantum* are resistant to NK-mediated cytolysis but are efficiently recognized by NKT cells.
86. Wei, D. G.; Curran, S. A.; Savage, P. B.; Teyton, L.; Bendelac, A. *J. Exp. Med.* **2006**, *203*, 1197-1207. Mechanisms imposing the V-beta bias of V-alpha-14 NKT cells and consequences for microbial glycolipid recognition.
85. Meyer, E. H.; Goya, S.; Akbari, Ol.; Berry, G. J.; Savage, P. B.; Kronenberg, M.; Nakayama, T.; DeKruyff, R. H.; Umetsu, D. T. *Proc. Natl Acad. Sci.* **2006**, *103*, 2782-2787. Glycolipid mediated activation of *i*NKT cells is sufficient to induce airway hyperreactivity independent of conventional CD4⁺ T cells.
84. Liu, Y.; Goff, R. D.; Zhou, D.; Mattner, J.; Sullivan, B. A.; Khurana, A.; Cantu, C.; Altman, J. D.; Teyton, L.; Bendelac, A.; Savage, P. B. *J. Immun. Methods* **2006**, *312*, 34-39. A modified α -galactosyl ceramide for staining and stimulating natural killer T cells.
83. Farruggia, G.; Iotti, S.; Prodi, L.; Montalti, M.; Zaccheroni, N.; Savage, P. B.; Trapani, V.; Sale, P.; Wolf, F. I. *J. Am. Chem. Soc.* **2006**, *127*, 344-350. 8-Hydroxyquinoline derivatives as fluorescent sensors for magnesium in living cells.
82. Kichler, A.; Leborgne, C.; Savage, P. B.; Danos, O. *J. Controlled Release* **2005**, *107*, 174-182. Cationic steroid antibiotics demonstrate DNA delivery properties.
81. Zajonc, D. M.; Cantu, C. III; Mattner, J.; Zhou, D.; Savage, P. B.; Bendelac, A.; Wilson, I. A.; Teyton, L. *Nature Immunol.* **2005**, *6*, 810-818. Structure and function of a potent α -galactosylceramide agonist for the semi-invariant NKT cell receptor.
80. Mattner, J.; DeBord, K. L.; Goff, R. D.; Cantu, C.; Zhou, D.; Saint-Mezard, P.; Wang, V.; Gao, Y.; Yin, N.; Hoebe, K.; Schneewind, O.; Ismail, N.; Walker, D.; Buetler, B.; Teyton, L.; Savage, P. B.; Bendelac, A. *Nature* **2005**, *434*, 525-528. Both exogenous and endogenous glycolipid antigens activate NKT cells during microbial infections.
79. Bronson, R. T.; Michaelis, D. J.; Lamb, R. D.; Hussein, G. A.; Farnsworth, P. B.; Linford, M. A.; Izatt, R. M.; Bradshaw, J. S.; Savage, P. B. *Org. Lett.* **2005**, *7*, 1105-1108. Efficient immobilization of a cadmium chemosensor in a thin film: generation of a cadmium sensor prototype.
78. Lua, Y. Y.; Fillmore, W. J. J.; Yang, L.; Lee, M. V.; Savage, P. B.; Asplund, M. C.; Linford, M. R. *Langmuir* **2005**, *21*, 2093-2097. First reaction of a bare silicon surface with acid chlorides and a one-step preparation of acid chloride terminated monolayers on scribed silicon.
77. Lua, Y. Y.; Yang, L.; Pew, C. A.; Zhang, F.; Fillmore, W. J. J.; Bronson, R. T.; Sathyapalan, A.; Savage, P. B.; Whittaker, J. D.; Davis, R. C.; Linford, M. R. *J. Am. Soc. Mass Spec.* **2005**, *16*, 1575-1582. Polyelectrolytes as new matrices for secondary ion mass spectrometry.
76. Zhou, D.; Mattner, J.; Cantu, C.; Schrantz, N.; Yin, N.; Gao, Y.; Sagiv, Y.; Hudspeth, K.; Wu, Y.; Yamashita, T.; Teneberg, S.; Wang, D.; Proia, R.; Lavery, S. B.; Savage, P. B.; Teyton, L.; Bendelac, A. *Science* **2004**, *306*, 1786-1789. Lysosomal glycosphingolipid recognition by NKT cells.
75. Ding, B.; Taotafa, U.; Orsak, T.; Chadwell, M.; Savage, P. B. *Org. Lett.* **2004**, *6*, 3433-3436. Synthesis and characterization of peptide-cationic steroid antibiotic conjugates.

74. Ding, B.; Yin, N.; Liu, Y.; Cardenas-Garcia, J.; Evanson, R.; Orsak, R.; Fan, M.; Turin, G.; Savage, P. B. *J. Am. Chem. Soc.* **2004**, *126*, 13642-13648. Origins of cell selectivity of cationic steroid antibiotics.
73. Goff, R. D.; Gao, Y.; Mattner, J.; Zhou, D.; Yin, N.; Cantu, C. III; Teyton, L.; Bendelac, A.; Savage, P. B. *J. Am. Chem. Soc.* **2004**, *126*, 13602-13603. Effects of lipid chain lengths in α -galactosylceramides on cytokine release by natural killer T cells.
72. Bronson, R. T.; Montalti, M.; Prodi, L.; Zaccheroni, N.; Lamb, R. D.; Dalley, N. K.; Izatt, R. M.; Bradshaw, J. S.; Savage, P. B. *Tetrahedron* **2004**, *60*, 11139-11144. Origins of "on-off" fluorescent behavior of 8-hydroxyquinoline-containing chemosensors.
71. Zhou, D.; Cantu, C. C.; Sagiv, Y.; Kulkarni, A. B.; Qi, X.; Morales, C.; Grabowski, G. A.; Benlagha, K.; Savage, P. B.; Bendelac, A.; Teyton, L. *Science* **2004**, *303*, 523-527. Editing of Cd1-bound lipid antigens by endosomal lipid transfer proteins.
70. Xue, G.; Bradshaw, J. S.; Dalley, N. K.; Savage, P. B.; Izatt, R. M. *J. Heterocyclic Chem.* **2003**, *40*, 383-388. Synthesis of trans-disubstituted cyclam ligands appended with two 6-hydroxymethylpyridin-2-ylmethyl sidearms: crystal structures of the 1,8-dimethyl-4,11-di(6-hydroxymethylpyridin-2-ylmethyl)cyclam ligand and its Co(II) and Ni(II) complexes.
69. Hook, G. L.; Kimm, G.; Betsinger, G.; Savage, P. B.; Swift, A.; Logan, T.; Smith, P. A. *J. Sep. Sci.* **2003**, *26*, 1091-1096. Solid phase microextraction sampling and gas chromatography/mass spectrometry for field detection of the chemical warfare agent *O*-ethyl-*S*-(*s*-diisopropylaminoethyl)methylphosphonothiolate (VX).
68. Song, H.-C.; Chen, Y. W.; Yao, J.-H.; Bradshaw, J. S.; Savage, P. B.; Izatt, R. M. *J. Heterocyclic Chem.* **2003**, *40*, 475-479. Synthesis of diazadithiacrown ethers containing appended coumarin or 1-aminonaphthalene sidearms.
67. Hook, G. L.; Kimm, G.; Koch, D.; Savage, P. B.; Ding, B.; Smith, P. A. *J. Chrom. A* **2003**, *992*, 1-9. Detection of VX contamination in soil through solid-phase microextraction sampling and gas chromatography-mass spectrometry of the VX degradation product bis(diisopropylaminoethyl)disulfide.
66. Cantu, C.; Benlagha, K.; Savage, P. B.; Bendelac, A.; Teyton, L. *J. Immunol.* **2003**, *170*, 4673-4682. The paradox of immune molecular recognition of α -galactosylceramide: low affinity, low specificity for CD1d, high affinity for $\alpha\beta$ T cell receptors.
65. Yin, N.; Marshall, R. L.; Matheson, S.; Savage, P. B. *J. Am. Chem. Soc.* **2003**, *126*, 2426-2435. Synthesis of lipid A derivatives and their interactions with polymyxin B and polymyxin B nonapeptide.
64. Kawakami, J.; Bronson, R. T.; Xue, G.; Bradshaw, J. S.; Izatt, R. M.; Savage, P. B. *Supramol. Chem.* **2003**, *1*, 221-227. Characterization of bis-8-hydroxyquinoline-armed diazatrithia-16-crown-5 and diazadibenzo-18-crown-6 ligands as fluorescent chemosensor for zinc.
63. Savage, P. B.; Li, C.; Taotafa, U.; Ding, B.; Guan, Q. *FEMS Lett.* **2002**, *217*, 1-7. Antibacterial properties of cationic steroid antibiotics.
62. Zhou, X. T.; Forestier, C.; Goff, R. D.; Li, C.; Teyton, L.; Bendelac, A.; Savage, P. B. *Org. Lett.* **2002**, *4*, 1267-1270. Synthesis and NKT cell stimulating properties of fluorophore and biotin appended 6"-amino-6"-deoxy-galactosylceramides.
61. Posner, R. G.; Savage, P. B.; Peters, A. S.; Macias, A.; DelGado, J.; Schwarz, G.; Sklar, L. A.; Hlavacek, W.; Goldstein, B. *Molecular Immunol.* **2002**, *38*, 1221-1228. A quantitative approach for studying IgE-Fc ϵ RI aggregation.
60. Chiu, Y.-H.; Park, S.-H.; Benlagha, K.; Forestier, C.; Jayawardena-Wolf, J.; Savage, P. B.; Teyton, L.; Bendelac, A. *Nature Immunol.* **2002**, *3*, 55-60. Multiple defects of antigen presentation and T cell development in mice expressing tail-truncated CD1d.
59. Kluchinsky, T. A. Jr.; Savage, P. B.; Fitz, R.; Smith, P. A. *AIHA Journal* **2002**, *63*, 493-496. Liberation of hydrogen cyanide and hydrogen chloride during high temperature dispersion of CS riot control agent.
58. Ding, B.; Guan, Q.; Walsh, J. P.; Boswell, J. S.; Winter, T. W.; Winter, E. S.; Boyd, S. S.; Li, C.; Savage, P. B. *J. Med. Chem.* **2002**, *45*, 663-669. Correlation of the antibacterial activities of cationic peptide antibiotics and cationic steroid antibiotics.
57. Savage, P. B. *Curr. Med. Chem. Anti-Infective Agents* **2002**, *3*, 293-304. Cationic steroid antibiotics.

56. Savage, P. B. *European J. Org. Chem.* **2002**, 759-768. Design, synthesis and characterization of cationic peptide and steroid antibiotics.
55. Xue, G.-P.; Bradshaw, J. S.; Dalley, N. K.; Savage, P. B.; Izatt, R. M.; Prodi, L.; Montalti, M.; Zaccheroni, N. *Tetrahedron* **2002**, *58*, 4809-4815. Synthesis of azacrown ethers with quinoline-based sidearms as potential zinc(II) fluorophores.
54. Song, H.-C.; Bradshaw, J. S.; Y.-W. Chen, Xue, G.-P.; Li, W.-M.; Krakowiak, K. E.; Savage, P. B.; Xu, Z.-L.; Izatt, R. M. *Supramolecular Chem.* **2002**, *14*, 263-269. Synthesis of new crown ethers containing appended pyridine, 10-hydroxybenzoquinoline, 8-hydroxyquinoline and 2-amino-1-hydroxybiphenyl sidearms.
53. Kluchinsky, T. A.; Sheely, M. V.; Savage, P. B.; Smith, P. A. *J. Chromatography A* **2002**, *952*, 205-213. Formation of 2-chlorobenzylidenemalononitrile (CS riot control agent) thermal degradation products at elevated temperatures.
52. Smith, P. A.; Kluchinsky, T. A.; Savage, P. B.; Erickson, R. P.; Lee, A. P.; Williams, K.; Stevens, M.; Thomas, R. J. *AIHA J.* **2002**, *63*, 284-292. Traditional sampling with laboratory analysis and solid phase microextraction sampling with field gas chromatography/mass spectrometry by military industrial hygienists.
51. Song, H. C.; Chen, Y.-W.; Song, J.-C.; Savage, P. B.; Xue, G.-P.; Chiara, J. A.; Krakowiak, K. E.; Izatt, R. M.; Bradshaw, J. S. *J. Heterocyclic Chem.* **2001**, *38*, 1369-1376. New diazadi(and tri)thia-21-crown-7 ethers containing 8-hydroxyquinoline side arms.
50. Xue, G.-P.; Bradshaw, J. S.; Dalley, N. K.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M.; Prodi, L.; Montalti, M.; Zaccheroni, N. *Tetrahedron* **2001**, *57*, 7623-7628. Convenient synthesis and preliminary photophysical properties of novel 8-aminoquinoline appended diaza-18-crown-6 ligands.
49. Xue, G.-P.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M.; Bradshaw, J. S. *J. Heterocyclic Chem.* **2001**, *38*, 1453-1457. Synthesis of diazadibenzo-18-crown-6 ligands with appended chromophoric and fluorophoric groups as potential metal ion chemosensors.
48. Song, H. C.; Bradshaw, J. S.; Chen, Y.-W.; Xue, G.-P.; Chiara, J. A.; Krakowiak, K. E.; Savage, P. B.; Xue, Z.-L.; Izatt, R. M. *ARKIVOK* **2001**, *2*, ms#116. Syntheses of diazadithiacrown ethers containing two 8-hydroxyquinoline side arms.
47. Kluchinsky, T. A., Jr.; Savage, P. B.; Sheely, M. V.; Thomas R. J.; Smith, P. A. *Microcolumn Sep.* **2001**, *13*, 186-190. Identification of CS-derived compounds formed during heat-dispersion of CS riot control agent.
46. Bradshaw, J. S.; Song, H.-C.; Xue, G.-P.; Bronson, R. T.; Chiara, J. A.; Krakowiak, K. E.; Savage, P. B.; Izatt, R. M. *Supramol. Chem.* **2001**, *13*, 499-505. Synthesis of diazadi(and tri)thiacrown ethers containing two 5-substituent(or 2-methyl)-8-hydroxyquinoline side arms.
45. Savage, P. B. *Annals of Med.* **2001**, *33*, 167-171. Multidrug resistant bacteria: overcoming antibiotic permeability barriers of Gram-negative bacteria.
44. Lee, S. C.; Izatt, R. M.; Zhang, X. X.; Nelsen, E. G.; Lamb, J. D.; Savage, P. B.; Bradshaw, J. S. *Inorg. Chim. Acta* **2001**, *317*, 174-180. Highly selective copper(II) ion receptors: tetraazacrown ethers bearing two 8-hydroxyquinoline side arms.
43. Bronson, R. T.; Bradshaw, J. S.; Savage, P. B.; Fuangwasdi, S.; Lee, S. C.; Krakowiak, K. E.; Izatt, R. M. *J. Org. Chem.* **2001**, *66*, 4752-4758. Bis-8-hydroxyquinoline-armed diazatrithia-15-crown-5 and diazathithia-16-crown-5 ligands: possible fluorophoric metal ion sensors.
42. Prodi, L.; Montalti, M.; Zaccheroni, N.; Bradshaw, J. S.; Izatt, R. M.; Savage, P. B. *J. Incl. Phenom.* **2001**, *41*, 123-127. pH dependence of the luminescent properties of metal ion complexes of 5-chloro-8-hydroxyquinoline appended diaza-18-crown-6.
41. Schmidt, E. J.; Boswell, S. R.; Walsh, J. P.; Schellenberg, M. M.; Winter, T. W.; Li, C.; Allman, G. W.; Savage, P. B. *J. Antimicrob. Chemother.* **2001**, *47*, 671-674. Activities of cholic acid-derived antimicrobial agents against multidrug-resistant bacteria.
40. Prodi, L.; Montalti, M.; Zaccheroni, N.; Bradshaw, J. S.; Izatt, R. M.; Savage, P. B. *Tetrahedron Lett.* **2001**, *42*, 2941-2944. Characterization of 5-methoxyquinoline appended diaza-18-crown-6 as a chemosensor for cadmium.
39. Dalley, N. K.; Xue, G.-P.; Bradshaw, J. S.; Zhang, X. X.; Harrison, R. G.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M. *J. Heterocyclic Chem.* **2001**, *38*, 1-9. A new diaza-18-crown-6 ligand containing two quinolin-

- 8-ylmethyl side arms: crystal structures and characterization of the ligand, the protonated ligand and its mononuclear barium (II) and dinuclear copper (II) complexes.
38. Xue, G.-P.; Bradshaw, J. S.; Song, H.-C.; Bronson, R. T.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M.; Prodi, L.; Montalti, M.; Zaccheroni, N. *Tetrahedron* **2001**, *57*, 87-91. A convenient synthesis and preliminary photophysical study of novel fluoroionophores: macrocyclic polyamines containing two dansylamidoethyl side arms.
 37. Zhou, X.-T.; Rehman, A.; Li, C.; Savage, P. B. *Org. Lett.* **2000**, *2*, 3015-3018. Preparation of a protected triamino-analogue of cholic acid and sequential incorporation of amino acids in solution and on a solid support.
 36. Taotafa, U.; McMullin, D. M.; Lee, S. C.; Savage, P. B. *Org. Lett.* **2000**, *2*, 4117-4120. Anionic facial amphiphiles from cholic acid.
 35. Guan, Q.; Schmidt, E. J.; Boswell, S. R.; Li, C.; Allman, G. W.; Savage, P. B. *Org. Lett.* **2000**, *2*, 2837-2840. Preparation and characterization of cholic acid-derived antimicrobial agents with controlled stabilities.
 34. Prodi, L.; Bargossi, C.; Montalti, M.; Zaccheroni, N.; Su, N.; Bradshaw, J. S.; Izatt, R. M.; Savage, P. B. *J. Am. Chem. Soc.* **2000**, *122*, 6769-6770. An effective fluorescent chemosensor for mercury ions.
 33. Savage, P. B.; Li, C. *Exp. Op. Invest. Drugs* **2000**, *9*, 263-269. Cholic acid derivatives: novel antimicrobials.
 32. Xue, G.-P.; Bradshaw, J. S.; Su, N.; Krakowiak, K. E.; Savage, P. B.; Izatt, R. M. *J. Heterocyclic Chem.* **2000**, *37*, 1-9. Syntheses of two 1,3-2,4-calix[4]bis-crown ethers containing two 1,2-phenylene and one pyridine or anisole units in each crown ether moiety.
 31. Su, N.; Bradshaw, J. S.; Xue, G.; Dalley, N. K.; Zhang, X. X.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M. *J. Heterocyclic Chem.* **2000**, *37*, 711-720. Synthesis, crystal structures, and metal ion complexation studies of novel diaza-18-crown-6 ligands containing aromatic thiol-derived side arms.
 30. Fleming, S. A.; Hart, G. R.; Savage, P. B. *J. Chem. Ed.* **2000**, *77*, 790-794. Molecular orbital animations for organic chemistry.
 29. Xue, G.-P.; Bradshaw, J. S.; Chiara, J. A.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M. *Syn. Lett.* **2000**, 1181-1183. A convenient synthesis of novel fluorophores: macrocyclic polyamines containing two dansylamidoethyl side arms.
 28. Xue, G.-P.; Savage, P. B.; Bradshaw, J. S.; Zhang, X. X.; Izatt, R. M. in *Advances in Supramolecular Chemistry, Vol. 7*; JAI Press, **2000**, pp. 99-137. Functionalized macrocyclic ligands as sensory molecules for metal ions.
 27. Bradshaw, J. S.; Izatt, R. M.; Savage, P. B.; Bruening, R. L.; Krakowiak, K. E. *Supramolecular Chem.* **2000**, *12*, 23-38. The design of ion selective macrocycles and the solid-phase extraction of ions using molecular recognition technology: A synopsis.
 26. Li, C.; Lewis, M. R.; Gilbert, A. B.; Noel, M. D.; Scoville, D. H.; Allman, G. W.; Savage, P. B. *Antimicrob. Agents. Chemother.* **1999**, *43*, 1347-1351. Antimicrobial activities of amine- and guanidine-functionalized cholic acid derivatives.
 25. Li, C.; Budge, L. P.; Driscoll, C. D.; Willardson, B. M.; Allman, G. W.; Savage, P. B. *J. Am. Chem. Soc.* **1999**, *121*, 931-940. Incremental conversion of outer-membrane permeabilizers into potent antibiotics for Gram-negative bacteria.
 24. Rehman, A.; Li, C.; Budge, L. P.; Street, S. E.; Savage, P. B. *Tetrahedron Lett.* **1999**, *40*, 1865-1868. Preparation of amino acid-appended cholic acid derivatives as sensitizers of Gram-negative bacteria.
 23. Li, C.; Rehman, A.; Dalley, N. K.; Savage, P. B. *Tetrahedron Lett.* **1999**, *40*, 1861-1864. Short syntheses of triamine-derivatives of cholic acid.
 22. Su, N.; Bradshaw, J. S.; Zhang, X. X.; Song, H.-C.; Savage, P. B.; Xue, G.-P.; Krakowiak, K. E.; Izatt, R. M. *J. Org. Chem.* **1999**, *64*, 8855-8865. Syntheses and metal ion complexation of novel 8-hydroxyquinoline-containing diaza-18-crown-6 ligands and analogs.
 21. Su, N.; Bradshaw, J. S.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M.; DeWall, S. L.; Gokel G. W. *Tetrahedron* **1999**, *55*, 9737-9746. Syntheses and aggregate study of bisphenol-containing diaza-18-crown-6 ligands.
 20. Su, N.; Bradshaw, J. S.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M. *J. Org. Chem.* **1999**, *64*, 3825-3836. Diaza-18-crown-6 ligands containing two aminophenol sidearms: new heterobinuclear metal ion receptors.

19. Yang, Z.; Bradshaw, J. S.; Zhang, X. X.; Savage, P. B.; Krakowiak, K. E.; Dalley, N. K.; Su, N.; Bronson, T.; Izatt, R. M. *J. Org. Chem.* **1999**, *64*, 3162-3172. New tetraazacrown ethers containing two pyridine, quinoline, 8-hydroxyquinoline or 8-aminoquinoline sidearms.
18. Su, N.; Bradshaw, J. S.; Savage, P. B.; Krakowiak, K. E.; Izatt, R. M. *J. Heterocyclic Chem.* **1999**, *36*, 771-780. Syntheses of diaza-18-crown-6 ligands containing two 4-hydroxyazobenzene, two benzimidazole, two uracil, two anthraquinone, or two ferrocene units.
17. Fleming S. A.; Hart, G. R.; Savage, P. B. *Organic Reaction Animations v1.5*; W. W. Norton: New York, **1999**. (Fleming S. A.; Hart, G. R.; Savage, P. B. *Organic Reaction Animations v1.0*; W. W. Norton: New York, **1998**.)
16. Li, C.; Peters, A. S.; Meredith, E. L.; Allman, G. H.; Savage, P. B. *J. Am. Chem. Soc.* **1998**, *120*, 2961-2962. Design and synthesis of potent sensitizers of Gram-negative bacteria based on a cholic acid scaffolding.
15. Prodi, L.; Bolletta, F.; Montalti, M.; Zaccheroni, N.; Savage, P. B.; Bradshaw, J. S.; Izatt, R. M. *Tetrahedron Lett.* **1998**, *39*, 5451-5454. A fluorescent sensor for magnesium ions.
14. Marshall, R. L.; Dalley, N. K.; Savage, P. B. *Tetrahedron Lett.* **1998**, *39*, 3923-3926. Synthesis of novel 3',6'-dideoxy-3',6'-epithio and 2',6'-dideoxy-2',6'-epithio nucleosides.
13. Smith, P. A.; Bowerbank, C. R.; Savage, P. B.; Drown, D. B.; Lee, M. L.; Alexander, W.; Jederberg, W. W.; Still, K. *Appl. Occ. Env. Hygiene* **1998**, *14*, 171-179. Conjugation of 7-oxodehydroabietic acid to lysine, a haptentation mechanism for an oxidized resin acid with dermal sensitizing properties.
12. Bordunov, A. V.; Bradshaw, J. S.; Bastushok, V. N.; Zhang, X. X.; Kou, X.; Dalley, N. K.; Yang, Z.; Savage, P. B.; Izatt, R. M. *Tetrahedron* **1997**, *53*, 17595-17603. Azacrown ethers containing oximic and Schiff base sidearms-potential heteronuclear metal ion receptors.
11. Savage, P. B.; Thomas, W. D.; Dalley, N. K. *J. Incl. Phenom.* **1997**, *29*, 335-339. Synthesis of two new glycophanes comprised of thioglucose molecules linked by hydrocarbons.
10. Holmgren, S. K.; Savage, P. B.; Desper, J. M.; Schladetzky, K. D.; Powell, D. R.; Gellman, S. H. *Tetrahedron*, **1997**, *53*, 12249-12257. Steric control of oxidation selectivity in macrocyclic phosphine oxide-dithioethers.
9. Paquette, L. A.; Sun, L.-Q.; Friedrich, D.; Savage, P. B. *J. Am. Chem. Soc.* **1997**, *119*, 8438-8439. Total synthesis of (+)-epoxydictymene. Application of alkoxy-directed cyclization to diterpenoid construction.
8. Paquette, L. A.; Sun, L.-Q.; Friedrich, D.; Savage, P. B. *Tetrahedron Lett.* **1997**, *38*, 195-199. Highly enantioselective total synthesis of natural epoxydictymene. An alkoxy-directed cyclization route to highly strained trans-oxabicyclo[3.3.0]octanes.
7. Savage, P. B.; Holmgren, S. K.; Gellman, S. H. *J. Am. Chem. Soc.* **1994**, *116*, 4069-4070. Anion and ion pair complexation by a macrocyclic phosphine oxide disulfoxide.
6. Savage, P. B.; Gellman, S. H. *J. Am. Chem. Soc.* **1993**, *115*, 10448-10449. Complexation of ammonium hexoses: evidence for contributions from OH-OH hydrogen bonds in a hydroxylic medium.
5. Savage, P. B.; Holmgren, S. K.; Gellman, S. H. *J. Am. Chem. Soc.* **1993**, *115*, 7900-7901. Optimization of a phosphine oxide-disulfoxide array for multipoint hydrogen bonding to ammonium ions.
4. Savage, P. B.; Holmgren, S. K.; Desper, J. M.; Gellman, S. H. *Pure Appl. Chem.* **1993**, *65*, 461-468. Macrocycles containing sulfur and phosphorus: structure and complexation properties.
3. Savage, P. B.; Desper, J. M.; Gellman, S. H. *Tetrahedron Lett.* **1992**, *33*, 2107-2110. Stereoselective oxidation of an eleven-membered heterocycle.
2. McDaniel, C. W.; Bradshaw, J. S.; Krakowiak, K. E.; Izatt, R. M.; Savage, P. B.; Tarbet, B. J.; Bruening, R. L. *J. Heterocyclic Chem.* **1989**, *26*, 413-419. Preparation of crown compounds containing allyloxymethyl or butenyl groups for attachment to silica gel or containing long chain lipophilic groups for use in liquid membrane systems.
1. Bradshaw, J. S.; Krakowiak, K. E.; Bruening, R. L.; Tarbet, B. J.; Savage, P. B.; Izatt, R. M. *J. Org. Chem.* **1988**, *53*, 3190-3197. Synthesis of (allyloxy)methyl-substituted diaza-18-crown-6 compounds for attachment to silica gel.

Issued US Patents

60. Savage, P. B.; Genberg, C. A.; Triplett, M. D. "Methods for treating lung infections and inflammation." US Patent #12,653,832. June 16, **2026**.
59. Savage, P. B. "Use of CSA compounds to stimulate stem cells and hair growth." US Patent #12,186,328. January 7, **2025**.
58. Savage, P. B. "Method of treating ciliated tissue using CSA micelles." US Patent #12,070,467. July 27, **2024**.
57. Savage, P. B. "Cationic steroidal antimicrobial compounds with urethane linkages." US Patent #12,030,912. July 9, **2024**.
56. Savage, P. B.; Genberg, C. A. "Methods for treating inflammation, autoimmune disorders and pain." US Patent #11,739,116. August 29, **2023**.
55. Savage, P. B.; Genberg, C. A.; Triplett, M. A. "Methods for treating lung infections and inflammation." US Patent 11,690,855. July 4, **2023**.
54. Savage, P. B. "Methods for treating inflammation, autoimmune disorders and pain." US Patent #11,524,015. December 13, **2022**.
53. Savage, P. B. "Cationic steroidal antimicrobials." US Patent #11,286,276. March 29, **2022**.
52. Savage, P. B.; Genberg, C.; Bracken, R. "Cationic steroidal antibiotic compositions for the treatment of dermal tissue." US Patent #11,253,634. February 22, **2022**.
51. Savage, P. B. "Use of cationic steroidal antimicrobials for sporicidal activity." US Patent #10,959,433. March 30, **2021**.
50. Savage, P. B. "Hydrogel materials incorporating eluting ceragenin compound." US Patent #10,676,501. June 9, **2020**.
49. Savage, P. B. "Cationic steroid antimicrobial compounds." US Patent #10,626,139. April 21, **2020**.
48. Savage, P. B.; Genberg, C. "Methods for treating inflammation, autoimmune disorders and pain." US Patent #10,568,893. February 25, **2020**.
47. Genberg, C.; Beus, C. S.; Savage, P. B. "Methods for treating fungal infections." US Patent #10,441,595. October 15, **2019**.
46. Savage, P. B.; Jacks, T. E.; Miller, R. A.; Thompson, A. S.; Randall, J. L. "Methods for the synthesis of ceragenins." US Patent #10,370,403. August 6, **2019**.
45. Genberg, C.; Beus, C. S.; Savage, P. B. "Methods for treating fungal infections." US Patent #10,238,665. March 26, **2019**.
44. Savage, P. B. "Radiolabeled cationic steroid antimicrobials and diagnostic methods." US Patent #10,227,376. March 12, **2019**.
43. Savage, P. B.; Genberg, C.; Bracken, R. "Cationic steroidal antimicrobial compositions for the treatment of dermal tissue." US Patent #10,226,550. March 12, **2019**.
42. Genberg, C.; Savage, P. B. "Methods for cellular proliferation and treating certain diseases." US Patent #10,195,215. February 5, **2019**.
41. Savage, P. B. "Cationic steroidal antimicrobial prodrug compositions and uses thereof." US Patent #10,155,788. December 18, **2018**.
40. Savage, P. B.; Genberg, C. "Ceragenin particulate materials and methods for making same." US Patent #10,039,285. August 7, **2018**.
39. Savage, P. B. "Cationic steroid antimicrobial diagnostic, detection, screening and imaging methods." US Patent #9,943,614. April 17, **2018**.
38. Genberg, C.; Savage, P. B. "Methods for reducing cellular proliferation and treating certain diseases." US Patent #9,943,529. April 17, **2018**.
37. Savage, P. B.; Genberg, C. "Anti-infective and osteogenic compositions and methods of use." US Patent #9,931,350. April 3, **2018**.
36. Beus, C.; Savage, P. B. "Lavage and/or infusion using CSA compounds for increasing fertility in a mammal." US Patent # 9,867,836. January 16, **2018**.
35. Genberg, C.; Savage, P. B. "Compositions and methods for treating bone diseases and broken bones." US Patent # 9,694,019. July 4, **2017**.

34. Beus, C. S.; Savage, P. B. "Methods and apparatus for cleaning or disinfecting a water delivery system." US Patent # 9,686,966. June 27, **2017**.
33. Savage, P. B. "Methods and products for increasing the rate of healing of tissue wounds." US Patent # 9,603,859. March 28, **2017**.
32. Savage P. B. "Hydrophobic ceragenin compounds and devices incorporating same." US Patent # 9,546,195. January 17, **2017**.
31. Savage, P. B. "Aerosols containing ceragenins compounds and methods of use thereof." US Patent # 9,533,063. January 3, **2017**.
30. Savage, P. B.; Randall, J. L. "Methods for the synthesis of ceragenins." US Patent # 9,527,883. December 27, **2016**.
29. Savage, P. B. "Cationic steroidal antimicrobial compounds and methods of manufacturing such compounds," US Patent # 9,434,759. September 6, **2016**.
28. Beus, C. S.; Savage, P. B. "Animal feed including cationic cholesterol additive and related methods," US Patent # 9,387,215. July 12, **2016**.
27. Beus, C. S.; Savage, P. B. "Treatment and prevention of mastitis," US Patent # 9,314,472. April 19, **2016**.
26. Savage, P. B.; Bendelac, A.; Teyton, L. "Bacterial glycolipid activation of CD1d-restricted NKT cells," US Patent # 9,295,722. March 29, **2016**.
25. Genberg, C.; Savage, P. B. "Methods and products for increasing the rate of healing of tissue wounds," US Patent # 9,161,942. October 20, **2015**.
24. Genberg, C.; Savage, P. B. "Compositions and methods for treating bone diseases and broken bones," US Patent # 9,115,746. October 13, **2015**.
23. Savage, P. B.; Bendelac, A.; Teyton, L. "6"-Amino-6"-deoxygalactosylceramides," US Patent # 9,045,512. June 2, **2015**.
22. Savage, P. B. "Hydrophobic ceragenin compounds and devices incorporating same," US Patent # 8,975,310. March 10, **2015**.
21. Savage, P. B.; Bloebaum, R. D.; Williams, D. L.; Sinclair, K. D.; Haymond, B. S. "Medical devices incorporating ceragenin-containing composites," US Patent # 8,945,217. February 3, **2015**.
20. Savage, P. B.; Genberg, C. "Incorporation of particulate ceragenins in polymers," US Patent # 8,932,614. January 13, **2015**.
19. Teyton, L.; Bendelac, A.; Savage, P. B. "Adjuvants and methods of use," US Patent # 8,932,594. January 13, **2015**.
18. Savage, P. B. "Articles incorporating absorbent polymer and ceragenin compound," US Patent # 8,784,857. July 22, **2014**.
17. Savage, P. B.; Teyton, L.; Bendelac, A. "Modified-galactosyl ceramides for staining and stimulating natural killer T cells," US Patent # 8,765,692. July 1, **2014**.
16. Savage, P. B. "Storage-stable, anti-microbial compositions including ceragenin compounds and methods of use," US Patent # 8,691,252. April 8, **2014**.
15. Hibbs, M.; Altman, S. J.; Jones, H. D. T.; Savage, P. B. "Methods for attaching polymerizable ceragenins to water treatment membranes using amine and amide linkages," US Patent # 8,557,031. October 15, **2013**.
14. Hibbs, M.; Altman, S. J.; Jones, H. D. T.; Savage, P. B. "Methods for attaching polymerizable ceragenins to water treatment membranes using silane linkages," US Patent # 8,530,002. September 10, **2013**.
13. Hibbs, M.; Altman, S. J.; Jones, H. D. T.; Savage, P. B. "Biofouling-resistant ceragenin-modified materials and structures for water treatment," US Patent # 8,529,681. September 10, **2013**.
12. Savage, P. B.; Bendelac, A.; Teyton, L. "Method of stimulating NKT with 6"-amino-6"-deoxygalactosylceramides," US Patent # 8,445,272. May 21, **2013**.
11. Teyton, L.; Bendelac, A.; Savage, P. B. "Modified α -galactosylceramides for staining and stimulating NKT cells," US Patent # 8,227,581. July 24, **2012**.
10. Savage, P. B.; Leung, D. L. "Cationic Steroid Antimicrobial Compositions and Methods of Use," US Patent # 8,211,879. July 3, **2012**.
9. Bendelac, A.; Zhou, D.; Teyton, L.; Savage, P. B. "Methods of Activating NKT Cells," US Patent # 7,998,739. August 16, **2011**.

8. Savage, P. B.; Bendelac, A.; Teyton, L. "6"-amino-6"-deoxygalactosylceramides," US Patent # 7,989,432. August 2, **2011**.
7. Teyton, L.; Bendelac, A.; Savage, P. B. "Adjuvants and Methods of Use," US Patent # 7,794,722. September 14, **2010**.
6. Savage, P. B.; Leung, D. L. "Cationic Steroid Antimicrobial Compositions and Methods of Use," US Patent # 7,754,705. July 13, **2010**.
5. Savage, P. B.; Bendelac, A.; Teyton, L. "6"-Amino-6"-Deoxygalactosylceramides," US Patent # 7,645,873. January 12, **2010**.
4. Savage, P. B.; Li, C. "Steroid Derived Antibiotics," US patent # 7,598,234. October 6, **2009**.
3. Savage, P. B.; Li, C. "Steroid Derived Antibiotics," US patent # 6,767,904. July 27, **2004**.
2. Savage, P. B.; Li, C. "Steroid Derived Antibiotics," US patent # 6,486,148. November 26, **2002**.
1. Savage, P. B.; Li, C. "Steroid Derived Antibiotics," US patent # 6,350,738. February 26, **2002**.