Atanu Biswas

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CAREER OVERVIEW & EXPERTISE

For 40 years, Dr. Biswas has made significant contributions to fields ranging from polymer/analytical/medicinal chemistry, to food research, and bio-energy. Dr. Biswas is internationally recognized for pioneering polymer synthesis and modifications and contributions to development of bio-based plastics, coatings, films, hydrogels, absorbents, and bio-lubricants derived from agricultural feedstocks such as polysaccharides, vegetable oil, protein, edible beans, cotton, agricultural byproducts. Techniques have included microwave, ionic liquid, enzyme, and extrusion, among others.

Achievement span both private (Hercules Incorporated, Wilmington, DE, USA) and government (USDA/ARS) sectors. During 14 years at Hercules four of his discoveries were patented and commercialized. Overall, his research groups contributed to millions of dollars in corporate sales. He joined USDA-ARS (2002), in **past 18 years**, he has authored/coauthored over 135 peer-reviewed journal publications.

In 2020 and 2023, Dr. Biswas was twice awarded Fulbright US Scholar to lead research in Brazil. In 2014, he was awarded the prestigious *Science Without Border Fellowship* (2014-16) by the government of Brazil, affording funds for post-doc fellows, travel, and related research funds for biopolymer research. Collaborations were built with leading Brazilian agricultural research institutes and included 6 trips & a total of 10 months stay in Brazil. In 2018, he was the opening keynote speaker for the Brazilian Soybean Growers Association conference, an event held every third year and attended by more than 1200 growers, processors, marketers, and research scientists. More recently (2019), the Organization for Economic Cooperation and Development (OECD) awarded Dr. Biswas a fellowship (4 months) in Spain to lead and collaborate on Bio-Packaging for Food. In April 2019 he was awarded the *Chemist of the Year* by the American Chemical Society (Heartland Section, Central Illinois). He got USDA 2019-22 grant winner on Pea, Lentil and Chickpea research ($100,000). In 2020 he got USDA ARS Innovation award ($25.000). In 2022 he got 1890 Faculty Research Sabbatical Program ($75,000). Research on starches grant was awarded to him by the Northarvest Bean Growers Association, MN (2009-2013, 250,000).

PROFESSIONAL EXPERIENCE

2002-present	GS-15, Lead Scientist, USDA, ARS, NCAUR, PPL Research Unit, Peoria, IL
1988-2002	Senior Research Chemist, Hercules Incorporated, Wilmington, DE
1987-1988	Research Associate, Case Western Reserve University, Cleveland, OH
1985-1987	Research Associate, University of Virginia, Charlottesville, VA

ACADEMIC EDUCATION
1980-1985 – PhD, Organic Chemistry, University of Notre Dame, USA
1977-1980 – M.S., Organic Chemistry, Calcutta University, Calcutta, India;
1973-1977 – B.S., Chemistry; Mathematics and Physics, St. Xavier's College, Kolkata, India

HONORS AND AWARDS
◊◊ Fulbright US Scholar, 2023-24 to lead research in Brazil.
◊◊ Fulbright US Scholar, 2020-21 to lead research in Brazil.
◊◊ 2019 Chemist of the Year by the American Chemical Society (Central Illinois)
◊◊ Fellowship, The Organization for Economic Cooperation and Development (OECD), 2019
◊◊ Science without Borders Scholarship Award, Brazilian Government, CNPQ, 2014-2016.
◊◊USDA Executive Potential Program, USDA Graduate School, Center for Leadership and Management, Washington, DC, 2011-2012
◊◊ Effective and Creative Leadership, Acting Research Leader Award, Center Director of Commodity Protection and Quality Research Unit (CPQRU), Parlier, CA, 2011
◊◊ Outstanding Design Award, USDA Personally Identifiable Information (Pii) Poster Contest, Chief Information Officer of USDA, Washington, DC, 2008
◊◊ Graduate Fellowship, University of Notre Dame, Notre Dame, IN, 1980-1984

GRANTS
1. Fulbright US Scholar, 2020-21 to lead research in Brazil, $5000/month plus travel grants.
2. USDA 2020 grant, Impact of Storage on Functionality and Nutritional and Phytochemical Compositions of Pea, Lentil and Chickpea. $20,000, August 2019 – September 2020.
3. Adriane Cherpinski was funded by the Brazilian Government (CNPq) for her stay at USDA Peoria laboratories. 2019.
4. OECD Fellowship, 3.5 months, Valencia, Spain to lead and collaborate on Bio-Packaging for Food. $11,500. 2019.
5. Extraction of soluble sugars using Natural deep eutectic solvents (NADES) from banana. Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) to Dr. Analia Gomez. to collaborate and reside in Illinois at my USDA Laboratory. $ 45,000, 2017-2018.
6. In 2014 the Federal Government of Brazil recognized Dr. Biswas' scientific achievements by awarding him the Science without Borders scholarship, which is a competitive three-year scholarship program awarded to internationally recognized technology leaders. With all expenses (about $60K) Administered through the Brazilian National Council for Scientific and Technological Development (CNPq). The program included a scholarship for a Brazilian Ph.D. student, and a Brazilian post doc to work with Dr. Biswas for one year in his lab at NCAUR, Peoria, IL. $100,000, 2014-2016,
7. North Harvest Bean Growers Association. Develop Non-Traditional Applications of Dry Edible Beans Principal Investigator on multi-year, multi-phase project $ 225,000 (2009-2014)

LANGUAGE SKILLS.
Fluent: English;
Limited: Portuguese and Spanish

SELECT PROFESSIONAL ACTIVITIES AND PRESENTATIONS (recent8 years)
Delivered more than 70 invited presentations at universities, professional and academic conferences, and private and companies. Some events below.
◊◊ Keynote Speaker Brazilian Soybean Conference, June 2018. This is Brazil's only soybean conference, occurring every third year. ◊◊ As an American Chemical Society (ACS) member (1985-present) attended 17 national meetings throughout the USA, delivering 17 presentations. (Also attended workshops on Patent Law, Washington, DC, and on The Role of Microwave in Organic Synthesis, New York City, NY (organized by ACS)). ◊◊ Organizer and Speaker, Chemistry and Utilization of Agro-Based Materials, ACS Fall Meeting, San Diego, CA, 2019. ◊◊ Organizer and Speaker Value-Added Derivatives from Agro-Based Raw Materials Symposium, ACS Fall Meeting, Boston, MA, August 2018. ◊◊ Organizer and Speaker, Chemical Modifications of Polysaccharides Symposium, ACS Spring Meeting, San Francisco, CA, 2017. ◊◊ Workshop presentations at Federal University of Rio de Janeiro, Rio de Janeiro, Brazil; University of Sao Paulo (USP), Sao Paulo, Brazil, 2015. ◊◊ Advised Thermoset Plastics, Rubber and Elastomers Technical Advisory Panel Meeting, Detroit, MI, on making polyurethanes from soybean oil, 2015. ◊◊ Organizer, ACS Division of Agricultural and Food Chemistry (AGFD), Advances in Natural Product Utilization: Synthesis, Mechanisms and Process Development Symposium, 245th ACS National Meeting, New Orleans, LA, 2013. ◊◊ Presentation at International Union of Pure and Applied Chemistry (IUPAC), Istanbul, Turkey. 2013. ◊◊ Presentation at 39th Annual Meeting United States-Japan Cooperative Program in Natural Resources (UJNR), Food and Agriculture Panel, Baltimore, MD. 2012. ◊◊ Presented and advised USA Dry Pea & Lentil Council and U.S. Dry Bean Council Pulse Health Initiative, Strategic Planning Workshop, Beltsville, MD. 2011. ◊◊ Presented at Starch Roundtable (SRT), Baltimore, MD. 2011. ◊◊ Grant proposal reviewer, USDA/Department of Energy (DOE), Biomass Research and Development Initiative Grants. 2011; Reviewed Small Business Innovation Research (SBIR) grant proposals, 2009, 2012.

SELECT PROFESSIONAL
◊◊ Invited member of Editorial Advisory Board, Industrial Crops and Products, 2014-Present. ◊◊ Since 2009, Dr. Biswas has supervised 3 post docs 4 graduate & undergraduate students and who worked in his laboratory. ◊◊ Regular reviewer of manuscripts for *Carbohydrate Polymers, Industrial Crops and Products, Starch, Journal of American Oil Chemist's Society, Green Chemistry, Biomacromolecules, Macromolecules, Food Chemistry, Journal of Applied Polymer Science, Journal of Agricultural and Food Chemistry, Tetrahedron Letters, Food Research International, Cereal Chemistry*, etc.

ENTERPRENEURIAL SPIRIT

Dr. Biswas established Biswas Records, the first company in the US to introduce digitally recorded, traditional Indian Bengali music. From 1992-2005, the company was the second largest producer of Bengali music in the world, producing over 220 compact disc (CD) titles. Biswas-label CDs and DVDs have been distributed world-wide through online retailers Amazon, Barnes & Noble, Border Books, and Tower Records. Biswas Records was a feature at each North American Bengali Convention (NABC); 5,000 to 9,000 attendees). Dr. Biswas's entrepreneurial success has resulted in receipt of two NABC awards, each recognition of highest distinction. In the United States, over 100,000 Indian and Bangladeshi households enjoy culturally relevant music distributed under the Biswas label.

As an Indian music cultural ambassador, I learned to appreciate the value of unselfish thinking, "*We cannot hold a torch to light another's path without brightening our own"*- Ben Sweetland

DIVERSITY INITIATIVES. My birthplace India is a land of great diversity in geography, religion, culture, food habits, clothing/attire and language. This diversity has instilled in its population—and me-- rich points of view.
◊◊ In 2022, USDA ARS awarded me the1890 Faculty Research Sabbatical Program award to increase the minority students in agricultural research. In 2023 & 2024 I will mentor & host (2 trips, 6 months) Professor Beni from Tennessee State University, one of the historically black colleges & universities (HBCU). ◊◊ While participating in the yearlong USDA Graduate School Executive Potential year long Program (2011), I actively sought an assignment contributing to USDA's *cultural transformation initiatives*. My proposal to increase work force diversity using social media was approved and fully funded by the Office of Outreach, Diversity, and Equal Opportunity (ODEO). I exploited a 60-day appointment as an advisor to Dr. McLellan, Director of USDA, and authored "Cultural Transformation in Action" in the **MyUSDA,** 2012. The audience for this publication is >100,000 USDA employees, academics, researchers and publicists. ◊◊ Taught 7th grade classes for a year in middle schools as a volunteer of Junior Achievement of Delaware (1990 – 2000). ◊◊ Served as mentor for school students as a volunteer in the Hercules Incorporated Mentorship program (1995 – 2000) ◊◊ Taught English in Brazil English schools as volunteer (2014-16). ◊◊ Chair, Midwest Area (MWA) Diversity and Equal Opportunity Council (2013-2015). ◊◊ Founding Editor, USDA, ARS, MWA Diversity Newsletter, MEDLEY, 2013. I named it and designed its artwork which is still being used for 6 years ◊◊ Wrote an article on Unconscious Bias.

PEER REVIEWED ARTICLES AND PATENTS

1, Miller, M.J., Biswas, A. and Krook, M.A. Practical synthetic approaches to the novel O-sulfonated-N-hydroxy-2-azetidinone antibiotics. Tetrahedron. 39(15):2571-2575. 1983.

2. Lee, B.H., Biswas, A. and Miller, M.J.A unique (1,2) anionic rearrangement of N-hydroxy-lactams. Application to the synthesis of bicyclic β-lactams. J. Org. Chem. 51(1):106-109. 1986.

3. Biswas, A. and Miller, M.J. Rearrangements of N-hydroxy β-lactams. Tetrahedron. 42(23):6421-6428. 1986.

4. Biswas, A., Eigenbrot, C. and Miller, M.J. Novel rearrangements of 2-pyrrolidinone derivative. J. Heterocycl. Chem. 26(11):2849-2851. 1987.

5. Sundberg, R.J., Dahlhausen, D.J., Manikumar, G., Mavunkel, B., Biswas, A., Srinivasan, V., King, Jr., F. and Waid, P. Preparation of 2-aryl- and 2-(aryloxymethyl)imidazo[1,2-*a*]pyridines and related compounds. J. Heterocycl. Chem. 25(1):129-137. 1988.

6. Sundberg, R.J., Dahlhausen, D.J., Manikumar, G., Mavunkel, B., Biswas, A., Srinivasan, V., Musallam, H.A., Reid, Jr., W.A. and Ager, A.L. Cationic antiprotozoal drugs. Trypanocidal activity of 2-(4-formylphenyl)imidazo [1,2-*a*]pyridinium guanylhydrazones and related derivatives of quaternary heteroaromatic compounds. J. Med. Chem. 33(1):298-307. 1990.

7. Reuben, J. and Biswas, A. Molecular weight of polyphenylene oxide as determined by carbon-13 NMR spectroscopy. Macromolecules. 24(1):648-650. 1991.

8. Sundberg, R.J., Dahlhausen, D.J., Manikumar, G., Mavunkel, B.J., Musallam, H.A., Biswas, A. and Varadarajan, S. U.S. Patent Number 5,204,352. Compounds exhibiting anti-parasitic activity and a method for their use. April 1993.

9. Biswas, A. and Klosiewicz, D.W. U.S. Patent Number 5,391,670. Alkylation resins from polycyclic aromatic compounds. February 1995.

10. Caronia, P.J., Keogh, M.J., Furno, J.S., Gross, L.H., Nelson, F.F., Nguyen, T.T. and Biswas, A. U.S. Patent Number 6,143,822. Polyethylene crosslinkable composition. November 2000.

11. Biswas, A., Caronia, P.J., Furno, J.S., Gross, L.H., Keogh, M.J., Nelson, F.F. and Nguyen, T.T. U.S. Patent Number 6,277,925 B1. Allyl compounds, compositions containing allyl compounds and processes for forming and curing polymer compositions. August 2001.

12. Klosiewicz, D. and Biswas, A. U.S. Patent Number 6,825,291 B2. Thermally polymerized copolymers made from styrene and dicyclopentadiene monomers. November 2004.

13. Biswas, A., Sessa, D.J., Lawton, J.W., Gordon, S.H. and Willett, J.L. Microwave-assisted rapid modification of zein by octenyl succinic anhydride. Cereal Chem. 82(1):1-3. 2005.

14. Biswas, A., Shogren, R.L. and Willett, J.L. Solvent-free process to esterify polysaccharides. Biomacromolecules. 6(4):1843-1845. 2005.

15. Stevenson, D.G., Biswas, A. and Inglett, G.E. Thermal and pasting properties of microwaved corn starch. Starch/Stärke. 57(8):347-353. 2005.

16. Biswas, A., Adhvaryu, A., Gordon, S.H., Erhan, S.Z. and Willett, J.L. Synthesis of diethylamine functionalized soybean oil. J. Agric. Food. Chem. 53(24):9485-9490. 2005.

17. Harry-O'kuru, R.E., Biswas, A. and Gordon, S.H. A facile synthesis of aminohydroxy triglycerides from new crop oils. J. Am. Oil Chem. Soc. 82(3):207-212. 2005.

18. Shogren, R.L. and Biswas, A. Preparation of water-soluble and water-swellable starch acetates using microwave heating. Carbohydr. Polym. 64(1):16-21. 2006.

19. Biswas, A., Saha, B C., Lawton, J.W., Shogren, R.L. and Willett, J.L. Process for obtaining cellulose acetate from agricultural by-products. Carbohydr. Polym. 64(1):134-137. 2006.

20. Kim, S., Xu, J., Biswas, A. and Willett, J.L. Shear-induced aggregate formation starch solutions. Carbohydr. Polym. 64(2):168-174. 2006.

21. Biswas, A., Shogren, R.L., Kim, S. and Willett, J.L. Rapid preparation of starch maleate half-esters. Carbohydr. Polym. 64(3):484-487. 2006.

22. Biswas, A., Willett, J.L., Gordon, S.H. and Cheng. H.N. Complexation and blending of starch, poly(acrylic acid), and poly(N-vinyl pyrrolidone). Carbohydr. Polym. 65(4):397-403. 2006.

23. Biswas, A., Shogren, R.L., Stevenson, D.G., Willett, J.L. and Bhowmik, P.K. Ionic liquids as solvents for biopolymers: Acylation of starch and zein protein. Carbohydr. Polym. 66(4):546-550. 2006.

24. Biswas, A. The effects of microwave irradiation on the structure, viscosity, thermal properties and lubricity of soybean oil. Ind. Crops Prod. 25(1):1-7. 2007.

25. Stevenson, D.G., Biswas, A., Jane, J.-L. and Inglett, G. Changes in structure and properties of starch of four botanical dispersed in the ionic liquid. Carbohydr. Polym. 67(1):21-31. 2007.

26. Biswas, A., Sharma, B.K., Willett, J.L., Vermillion, K., Erhan, S.Z. and Cheng, H.N. Novel modified soybean oil containing hydrazino-ester: Synthesis and characterization. Green Chem. 9(1):85-89. 2007.

27. Biswas, A., Selling, G., Appell, M., Woods, K., Willett, J.L. and Buchanan, C. M. Iodine catalyzed esterification of cellulose using reduced levels of solvent. Carbohydr. Polym. 68(3):555-560. 2007.

28. Selling, G., Biswas, A., Patel, A., Walls, D.J., Dunlap, C. and Wei, Y. Impact of solvent on electrospinning of zein and analysis of resulting fibers. Macromol. Chem. Phys. 208(9):1002-1010. 2007.

29. Selling, G., Woods, K.K., Sessa, D.J. and Biswas, A. Electrospun zein fibers using glutaraldehyde as the cross-linking reagent - effect of time and temperature. Macromol. Chem. Phys. 209(10):1003-1011. 2007.

30. Stevenson, D., Inglett, G.E., Chen, D., Biswas, A., Eller, F.J. and Evangelista, R.L. Phenolic content and antioxidant activity of supercritical carbon dioxide treated and air-classified oat bran concentrate microwave-irradiated in water or ethanol at varying temperatures. Food Chem. 108(1):23-30. 2008.

31. Biswas, A., Sharma, B.K., Willett, J.L., Erhan, S.Z. and Cheng, H.N. Room-temperature self-curing gene reactions involving soybean oil. Green Chem.10(1):298-303. 2008.

32. Biswas, A., Shogren, R.L., Selling, G., Salch, J., Willett, J.L. and Buchanan, C.M. Rapid and environmentally friendly preparation of starch esters. Carbohydr. Polym. 74(1):137-141. 2008.

33. Biswas, A., Sharma, B.K., Willett, J.L., Advaryu, A., Erhan, S.Z. and Cheng, H.N. Azide derivatives of soybean oil and fatty esters. J. Agric. Food Chem. 56(14):5611-5616. 2008.

34. Biswas, A., Sharma, B.K., Willett, J.L., Erhan, S.Z. and Cheng, H.N. Soybean oil as a renewable feedstock for nitrogen-containing derivatives. Energy Environ. Sci. 1(6):639-644. 2008.

35. Shogren, R.L., Willett, J.L. and Biswas, A. HRP-mediated synthesis of starch-polyacrylamide graft copolymers. Carbohydr. Polym. 75(1):189-191. 2009.

36. Saha, B., Biswas, A. and Cotta, M. Microwave pretreatment, enzymatic saccharification, and fermentation of wheat straw to ethanol. J. Biobased Mater. Bioenergy. 2(3):210-217. 2008.

37. Biswas, A., Selling, G.W., Woods, K.K. and Evans, K. Surface modification of zein films. Ind. Crops Prod. 30(1):168-171. 2009.

38. Selling, G.W., Woods, K.K., Biswas, A. and Willett, J.L. Reactive extrusion of zein with glyoxal. J. Appl. Poly. Sci. 113(3):1828-1835. 2009.

39. Biswas, A., Cheng, H.N., Selling, G.W., Willett, J.L. and Kendra, D.F. Synthesis of phenyl-adducted cyclodextrin through click reaction. Carbohydr. Polym. 77:681-685. 2009.

40. Biswas, A., Shogren, R.L. and Willett, J.L. Ionic liquid as a solvent and catalyst for acylation of maltodextrin. Ind. Crops Prod. 30(1):172-175. 2009.

41. Biswas, A., Sharma, B.K., Doll, K., Willett, J.L., Erhan, S.Z., Vermillion, K. and Cheng, H.N. Synthesis of an amine-oleate derivative using an ionic catalyst. J. Agric. Food Chem. 57(1):8136-8141. 2009.

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43. Inglett, G., Rose, D., Stevenson, D., Chen, D. and Biswas, A. Total phenolics and antioxidant activity of extracts from distillers' dried grains. Cereal Chem. 86(6):661-664. 2009.

44. *Sutivisedsak, N*., Cheng, H.N., Willett, J.L., Lesch, W.C., Tangsrud, R.R. and Biswas, A. Microwave-assisted extraction of phenolics from bean (*Phaseolus vulgaris* L.). Food Res. Int. 43(2):516-519. 2010.

45. Cheng, H.N., Dowd, M.K., Selling, G.W. and Biswas, A. Synthesis of cellulose acetate from cotton byproducts. Carbohydr. Polym. 80(2):449-452. 2010.

46. Shogren, R., Biswas, A. and Willett, J.L. Preparation and physical properties of starch stearates of low to high degree of substitution. Starch/Stärke. 62(7):333-340. 2010.

47. Shogren, R.L. and Biswas, A. Acetylation of starch with vinyl acetate in imidazolium ionic liquids and characterization of acetate distribution. Carbohydr. Polym. 81(1):149-151. 2010.

48. *Sutivisedsak, N.*, Moser, B.R., Sharma, B.K., Evangelista, R.L., Cheng, H.N., Lesch, W.C., Tangsrud, R.R. and Biswas, A. Physical properties and fatty acid profiles from black, kidney, great northern, and pinto beans. J. Am. Oil Chem. Soc. 88(2):193-200. 2011.

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53. Cheng, H.N., Dowd, M.K., Shogren, R.L. and Biswas, A. Conversion of cotton byproducts to mixed cellulose esters. Carbohydr. Polym. 86(3):1130-1146. 2011.

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55. Selling, G.W. and Biswas, A. Compatible blends of zein and nylon-6. J. Polym. Environ. 20(1):631. 2012.

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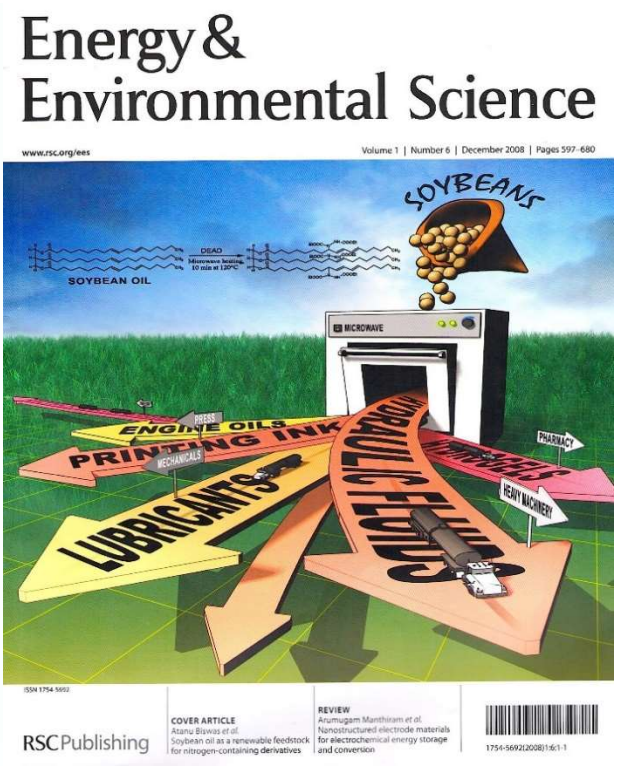
Scientists & artists (Real Artists Ship Products - Steve Jobs) Similarities between how artists and scientists work far outweigh their stereotypical differences. Many of the qualities of a successful scientist and a talented artist are the same. They are the two great modes of human thought, both pushing the boundaries of our imagination. They are intuitive, they have the willingness to throw out the rules. They both require a great deal of creativity; they need to have the ability to see patterns where others see chaos.

I enjoy art and photography as my hobby. I was honored to be invited to design several artworks which were used for scientific journal covers which published my research work, outreach/mission/marketing posters used by commodity producers or organizations. I also named the outreach newsletters Medley & Chorus. Medley has been in use by USDA MWA newsletter header for 10 years. Here are some of the artworks that I created.

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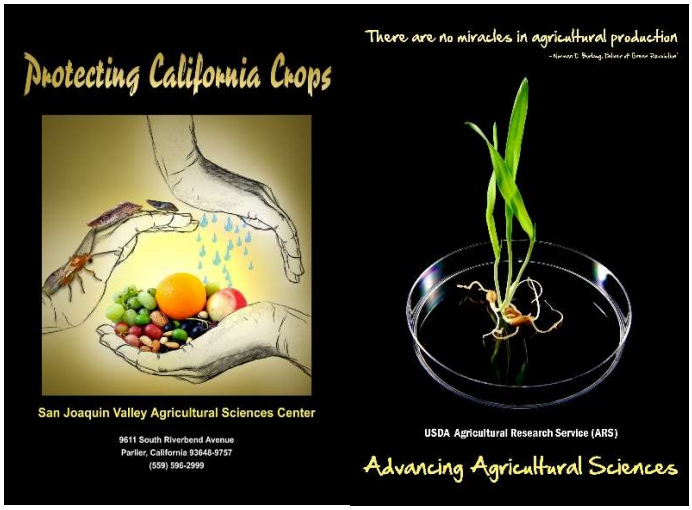
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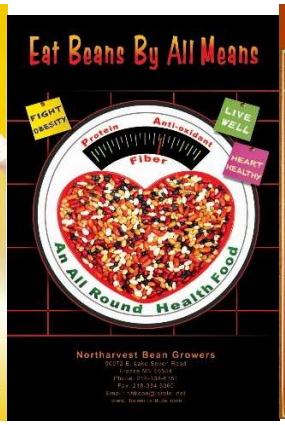
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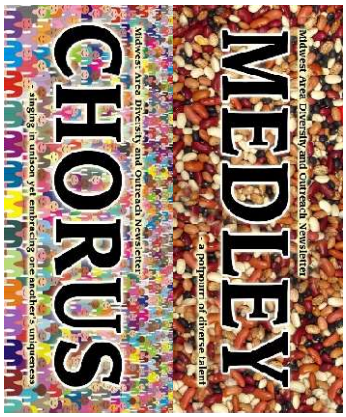
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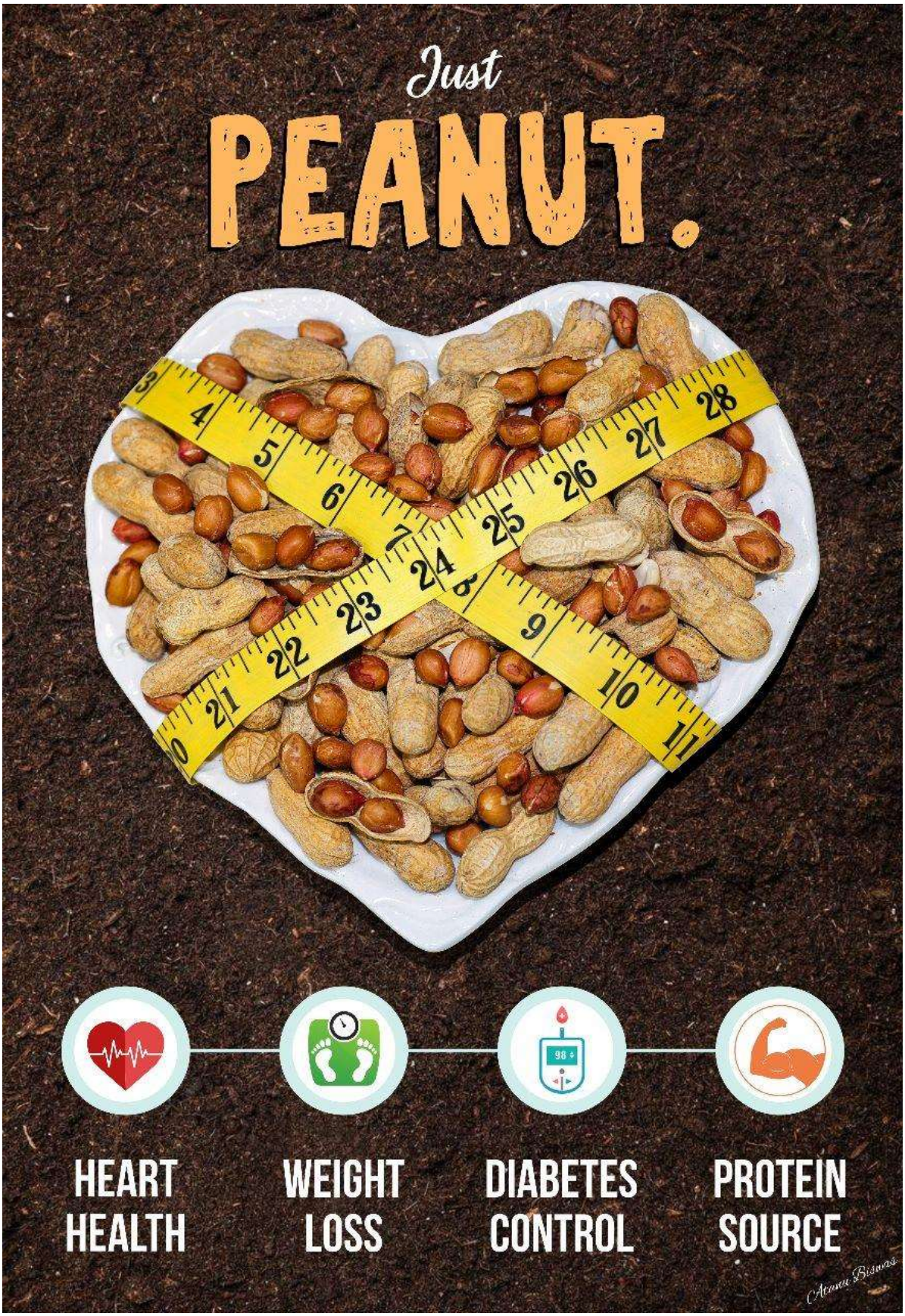
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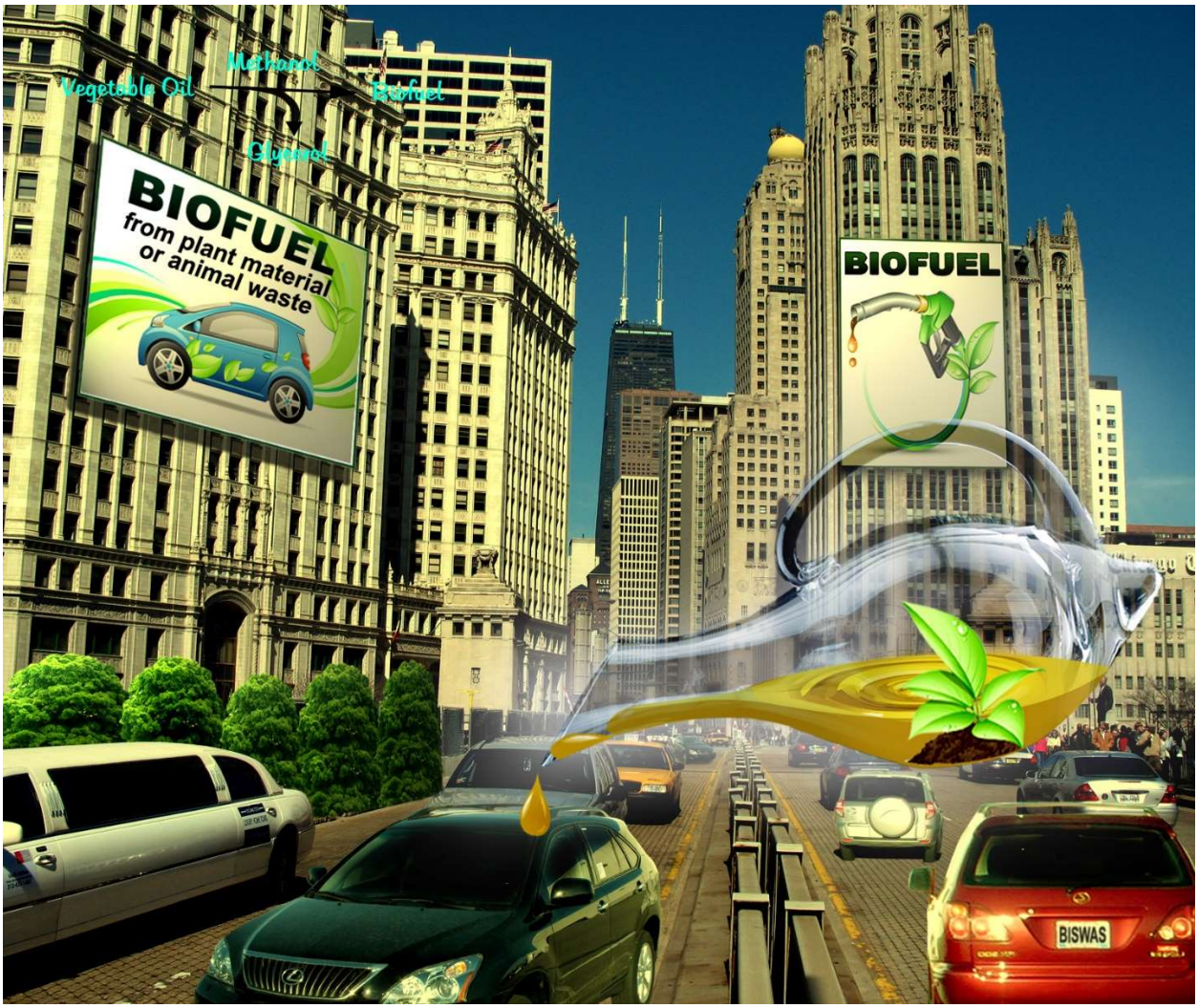
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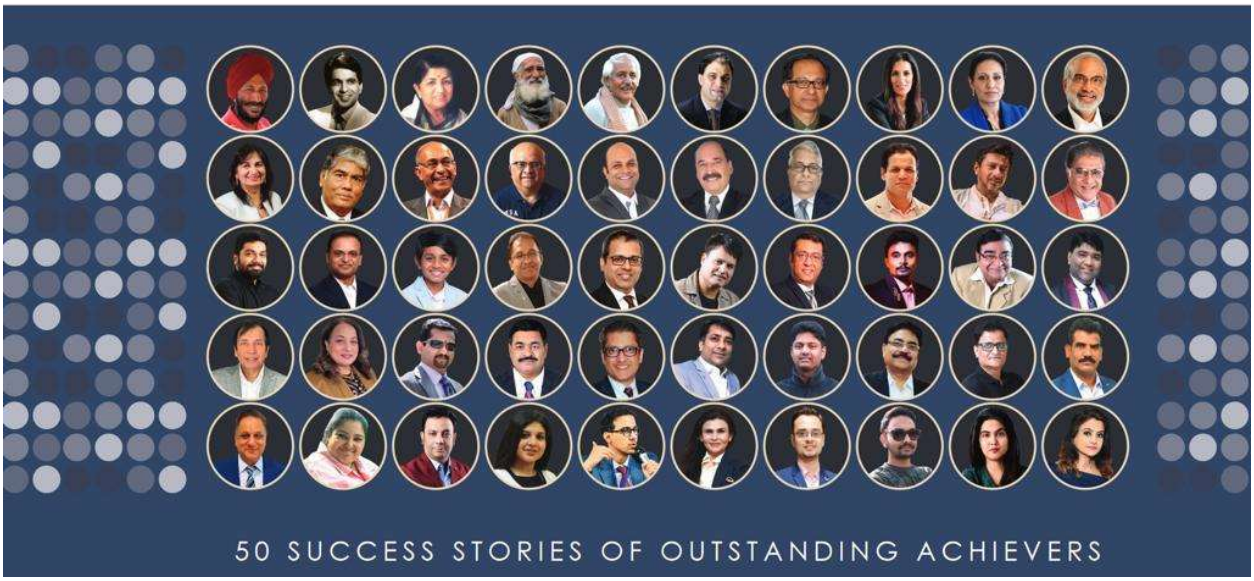
50 SUCCESS STORIES OF OUTSTANDING ACHIEVERS

He was awarded the ambassadorship of Bengali music in USA twice by North American Bengali Conference. In the late 90s, among the US Bengali community he was the most respected and well-known Bengali living in the US.

A Man of Many Talents

Dr. Atanu Biswas is a man of many talents. He is a music aficionado and a scientist at the same time. Dr. Biswas has contributed immensely in spreading Bengali and classical music across the entire USA. He founded Biswas Records to produce first digitally recorded Bengali music CD in 1994. In the history of Bengali music, nobody worked as hard and accomplished so much to propagate Bengali or Indian music outside India by producing over 200 CDs (compact discs) and DVDs in USA.

He was awarded the ambassadorship of Bengali music in USA twice by North American Bengali Conference. In the late 90s, among the US Bengali community he was the most respected and well-known Bengali living in the US. He is an inspiration to the young Bengalis - a Scientist both in industrial and academic chemistry research.

While managing Biswas Records, Atanu was also busy in inventing chemicals which became commercial products covered by patents. His scientific, entrepreneurial, and leadership skills also helped him to win international prestigious awards such as Scientists Without Borders from Brazil, OECD award from the European Union, and the 2020-2023 US Fulbright award from the U.S. Government for conducting research in Brazil on biodegradable plastics.

When Atanu Biswas was growing up in Calcutta, his parents made his future options clear. "In the United States you can do what you want to be but in India there are lesser opportunities. Either you can become a doctor, engineer or a scientist. Biswas planned to major in art or music, but he had to fulfil his parents promise. Eventually, he came to United States and earned a PhD in chemistry from the University of Notre Dame in 1985. Yet, through his research, he has managed to put his scientific degree to creative use: taking foods and leftover crops and experimenting with ways to turn them into sustainable alternatives to plastic. While sustainability is a complicated goal to reach, it is the one that Biswas is happy to be working towards it.

After completing his postdoctoral research, Biswas spent the first decade and a half of his professional life working with synthetic polymers. But he was not happy with the result as he wanted to make something organic so that it could disintegrate in nature. He started experimenting with biopolymers, or polymers made from natural materials grown in abundance, like soy.

In 2004, the U.S. Department of Agriculture (USDA) offered Biswas an opportunity to experiment with natural materials. "My job was to dabble with all these biopolymers," Biswas says about his work as a chemist with the USDA's Agricultural Research Service in Peoria, Ill.

A key part of Biswas' research involved using microwave reactors, the energy from which he applies to a wide range of natural materials so they can replace harsher or less biodegradable options. Microwave reactors have played a large role in Biswas' research over the past 15 years. He uses microwave energy to rapidly alter the structure of raw materials so they can be used in commercial applications in place of synthetic polymers.

In 2015, Biswas was awarded the Science Without Borders prize of $150,000 to study bio-based packaging with the Enterprise for Agricultural Research in Brazil, working with sugarcane, starches, and cashew nuts.

Biswas has also used microwave reactors to transform natural ingredients into sealants, medicine tablets, and packaging. Using microwave reactors can in some cases yield environmental benefits. "The actual production is much cleaner," says Biswas. Sometimes there is a pronounced effect from the reactor that is unexplainable, something called "the microwave effect," which Biswas uses to his advantage. "When you heat, you have a lot of bi-products and you have to purify, but with the microwave you don't have to purify to get a very clean product," he explains. It is also far more efficient, speeding up the reaction time to hours or minutes instead of days.

In another set of experiments, findings from which were published in the June 2019 issue of LWT - Food Science and Technology, Biswas and his team tested ways to extract dietary fibre from overripe bananas, leaving excess sugar behind. His team used natural solvents rather than harsher ingredients like ethanol, resulting in a cleaner process. Biswas has also used microwave extraction methods to pull out healthful Phyto chemicals from beans and pulses.

Sometimes Biswas employs technology to analyze foods and crops, not just change their structure. In a collaboration with Clifford Hall, a food science professor at South Dakota State University, the team set out to discover the ideal environment for storing pulses like peas, kidney beans, and chickpeas, crops that are essential sources of nutrition in many countries. Hall says Biswas used nuclear magnetic resonance scans to help the team zero in on the right temperature and humidity to best preserve photochemical, amino acids, and protein levels in pulses stored for months or years at a time. "We can do a lot of the functionality tests, but he's there to really go a little bit deeper into the chemistry of the changes," explains Hall.

Despite his contributions to food science, Biswas never completely abandoned his dream to create art. Over the years, his original photography and graphic design has accompanied many of his scientific publications and projects. In late November, he was plotting out a photo shoot to feature some of the pulses he studied with Hall. "The pulses are very colourful," he says with excitement. "They have different shapes and sizes." Its clear art is still a source of inspiration: "I enjoy art," he says with a smile.

Atanu Biswas in news:

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