

## CURRICULUM VITAE

### **Alip Borthakur, Ph.D.**

Assistant Professor  
Department of Clinical & Translational Sciences  
Marshall University  
Robert Byrd Biotechnology Center  
1700 3<sup>rd</sup> Avenue  
Huntington, WV 25703

### **Phone:**

304-696-5079 (Office)  
815-671-8913 (Cell)

**Email:** [borthakur@marshall.edu](mailto:borthakur@marshall.edu)

### **EDUCATION**

- **Ph.D., Biochemistry**, 1990, Central Food Technological Research Institute, University of Mysore, Mysore, India
- **M.S., Biochemistry**, 1979, Punjab Agricultural University, Ludhiana, India

### **POSTDOCTORAL TRAINING**

- **Postdoctoral Research Associate**, August 2003-July 2008, Division of Gastroenterology & Hepatology, Department of Medicine, University of Illinois at Chicago, USA
- **Postdoctoral Research Associate**, February 2001- July 2003, Department of Immunology and Microbiology, University of Illinois at Chicago, USA
- **Postdoctoral Research Scientist**, April 1997-April 1998, Department of Genetics, John Innes Centre, Norwich, UK

### **ACADEMIC APPOINTMENTS IN THE USA**

#### **CURRENT:**

- **Assistant Professor (Tenure-track)**, June 2019 - present, Department of Clinical & Translational Sciences, School of Medicine, Marshall University, Huntington WV, USA

#### **PREVIOUS:**

- **Assistant Professor (Research-track)**, August 2009-2019, Division of Gastroenterology & Hepatology, Department of Medicine, University of Illinois at Chicago, USA
- **Honors College Faculty**, August 2017- June 2019, Honors College, UIC

## PREVIOUS ACADEMIC APPOINTMENTS ABROAD

- **Associate Professor**, September 1991- January 2001, Department of Biotechnology, Assam Agricultural University, Jorhat, India
- **Visiting Scientist**, March 1995-March 1997, Microbiology Section, Division of Life Sciences, King's College London, London, UK
- **Assistant Professor**, April 1984-August 1991, Department of Biochemistry, Assam Agricultural University, Jorhat, India

## MERITS/AWARDS/FELLOWSHIPS

- **New Investigator Award**, 2013, American Physiological Society (APS), Gastrointestinal & Liver Section
- **Travel award**, 2011, Federation of American Societies for Experimental Biology (FASEB) to participate in the Summer Research Conference on *Probiotics: Physiological and clinical implications* at Carefree, Arizona, USA
- **Travel award**, 2010, American Gastroenterological Association (AGA) to attend *Academic Skills Workshop* at Houston, Texas, USA
- **Junior & Senior Research Fellowships**, 1985-1990, Council of Scientific & Industrial research (CSIR), India, during Ph.D. program
- **University Gold Medal**, 1976, Assam Agricultural University, Jorhat, India for securing first position in B.S. (Agriculture)

## CURRENT & PREVIOUSLY FUNDED RESEARCH PROJECTS AND FUTURE PLANS

Funding Agency	Type of Grant	Project Title	Role/Percent Efforts	Period/Direct Cost
<b>CURRENT</b>				
NIH/NIAID	R21	Establishment of a human enteroid model of cryptosporidiosis	Principal Investigator	05/21/18-04/30/20 \$275,000
<b>PREVIOUS</b>				
Bill and Melinda Gates Foundation	Grand Challenge Explorations: Phase I	A Novel Probiotic-based Approach to Improve Child Nutrition	Principal Investigator	05/01/12-04/30/14 \$100,000
NIH/NIDDK	R01	Probiotics: Potential Therapeutic Role in Diarrhea	Co-investigator	07/01/13-06/30/19 \$1,087,500
NIH/NIDDK	R01	Intestinal Anion Transporters: Function and Regulation	Co-investigator	08/05/18-06/30/19 \$1,738,769
Department of Veteran Affairs	Merit Review	Mechanisms of NaCl absorption in Human Colon	Co-investigator	01/01/17-06/30/19 \$650,000

		<b>FUTURE PLANS</b>		
NIH/NIAID	R01	Molecular Pathophysiology of Cryptosporidiosis	Principal Investigator	To be submitted: June 2020 cycle
NIH	COBRE ACCORD	Role of Gut Microbiota in Modulating Epithelial Enterendocrine Cell Function in Obesity	Principal Investigator	

## **MEMBERSHIP IN PROFESSIONAL SOCIETIES**

- **American Gastroenterological Association**, 4930 Del Ray Avenue, Bethesda, MD 20814, member since 2009
- **American Physiological Society**, 9650 Rockville Pike, Bethesda, MD 20814, member since 2013

## **REVIEWER/EDITORIAL BOARD MEMBER FOR JOURNALS/ FUNDING AGENCIES**

### **Editorial Board Member**

- Journal of Gastroenterology, Pancreatology and Liver Disorders, an open excess journal of the Symbiosis group of publications

### **Reviewer of Journals**

- PLoS One
- Cellular Microbiology
- Journal of Cellular Biochemistry
- DNA and Cell Biology
- Current Drug Metabolism
- Developmental Biology
- Molecular & Cellular Biochemistry
- Journal of American College of Nutrition
- Comprehensive Physiology
- Inflammatory Bowel Diseases

**Reviewer in Funding Agency:** Have been assigned to review proposals submitted to the following agency for funding:

- Broad Medical Foundation, CCFA, USA
- US Department of Defense, Peer-review Medical research program (PRMRP), Pre-gastrointestinal diseases (Pre-GID)

## **TEACHING EXPERIENCE/ ACADEMIC ACTIVITIES**

### **Marshall University**

1. **Member of the MD/Ph.D. Interview Committee**

2. **Designed a Graduate Level Course for the Department of Clinical and Translational Sciences entitled “Diet, Gut Microbiota and Human Health and Disease”**

### **COURSES/ ACADEMIC ACTIVITIES DURING PREVIOUS EMPLOYMENT AT UIC**

#### **Years 2017-2019**

- Taught HON 201 SEMINAR (a course offered to UIC Honors College undergraduates)
- UIC Honors College Academic Advisory program: Served as academic advisor for 6 Honors College students
- Taught Core Lecture Series (AY 2015-16) (Lectures on specialized topics for fellows of the GI fellowship program, Division of Gastroenterology & Hepatology, UIC)

#### **Years 2012-2016**

- Taught BMS-653 Physiology I (Basic course for the 1st year medical students)
- Taught PHY-B552 (Translational and Applied Physiology Graduate Course) in the Department of Physiology and Biophysics, UIC

### **PREVIOUS TEACHING ABROAD:**

- **Assam Agricultural University, Jorhat, Assam, India:** Involved in teaching the following courses during academic appointments as Assistant Professor (1984-1990) and Associate Professor (1991-2000)

#### **Undergraduate courses**

Introduction to General Biochemistry

Human Nutrition

Plant and Animal Biochemistry

#### **Graduate courses**

Intermediary metabolism

Vitamins and Hormones: Mechanisms of Action

Enzymology

Molecular Cell Biology

Immunology

Biochemical Laboratory techniques

- **King's College London, United Kingdom:** Involved in teaching laboratory techniques in Molecular Microbiology to undergraduate students during employment as Visiting Scientist (1995-1997) in the Microbiology Department.

## PUBLICATIONS

1. Priyamvada S, Anbazhagan AN, Kumar A, Chatterjee I, **Borthakur A**, Saksena S, Gill RK, Alrefai WA, Dudeja PK. All-trans Retinoic Acid Counteracts Diarrhea and Inhibition of Downregulated in Adenoma Expression in Gut Inflammation. *Inflamm Bowel Dis*. 2019. [Epub ahead of print]
2. Kumar A, Jayawardena D, Anbazhagan AN, Chatterjee I, Priyamvada S, Gill RK, Alrefai WA, **Borthakur A**, Dudeja PK (2019). Decreased SLC26A3 expression and function in intestinal epithelial cells in response to *Cryptosporidium parvum* infection. **Am J Physiol Cell Physiol** 317, C1205-1212 \*Corresponding author
3. Anbazhagan AN, Priyamvada S, **Borthakur A**, Saksena S, Gill RK, Alrefai WA, Dudeja PK (2019). miR-125a-5p: A Novel Regulator of SLC26A6 Expression in Intestinal Epithelial Cells). **Am J Physiol Cell Physiol** 317, C200-C208
4. Kumar A, Chatterjee I, Anbazhagan AN, Jayawardena D, Priyamvada S, Alrefai WA, Sun J, **Borthakur A**, Dudeja PK (2018). *Cryptosporidium parvum* disrupts intestinal epithelial barrier function via altering expression of key tight junction and adherens junction proteins. **Cellular Microbiology** 20, e12830, 1-13 \*Corresponding author
5. Muthusamy S, Jeong JJ, Cheng M, Bonzo JA, Kumar A, Gonzalez FJ, **Borthakur A**, Dudeja PK, Saksena S, Malakooti J. Hepatocyte Nuclear Factor 4 $\alpha$  Regulates the Expression of Intestinal Epithelial Na $^{+}$ /H $^{+}$  Exchanger Isoform-3 (NHE3) (2017). **Am J Physiol Gastrointest Liver Physiol**, 314, G14-G21
6. Kumar A, Chatterjee I, Gujral T, Alakkam A, Coffing H, Anbazhagan AN, **Borthakur A**, Saksena S, Gill RK, Alrefai WA, Dudeja PK (2017) Activation of Nuclear Factor- $\kappa$ B by Tumor Necrosis Factor in Intestinal Epithelial Cells and Mouse Intestinal Epithelia Reduces Expression of the Chloride Transporter SLC26A3. **Gastroenterology**, 153, 1338-1350
7. Chatterjee I, Kumar A, Castilla Madrigal RM, Pellon-Cardenas O, Gill RK, Alrefai WA, **Borthakur A**, Verzi M, Dudeja PK (2017). CDX2 upregulates SLC26A3 gene expression in intestinal epithelial cells. **Am J Physiol Gastrointest Liver Physiol** 313, G256-G264
8. Kumar A, Natarajan Anbazhagan A, Coffing HP, Chatterjee I, Priyamvada S, Gujral T, Saksena S, Gill RK, Alrefai WA, **Borthakur A**, Dudeja PK (2016). *Lactobacillus acidophilus* counteracts inhibition of NHE3 and DRA expression and alleviates diarrheal phenotype in mice infected with *Citrobacter rodentium*. **Am J Physiol Gastrointest Liver Physiol**, 311:G817-G826 **Corresponding author**
9. Anbazhagan AN, Priyamvada S, Alakkam A, Kumar A, **Borthakur A**, Saksena S, Gill RK, Alrefai WA, Dudeja PK (2016). Transcriptional modulation of SLC26A3 (DRA) by spingosine-1-phosphate. **Am J Physiol Gastrointest Liver Physiol** 310, G1028-1035

10. Anbazhagan AN, Priyamvada S, Gujral T, Alrefai WA, Dudeja PK and **Borthakur A (2016)**. A novel anti-inflammatory role of GPR120 in intestinal epithelial cells. **Am J Physiol Cell Physiol**, 310, C612-621 \* **corresponding author**
11. Kumar A, Alrefai WA, **Borthakur A**, Dudeja PK (2015). Lactobacillus acidophilus counteracts enteropathogenic E. coli-induced inhibition of butyrate uptake in intestinal epithelial cells. **Am J Physiol Gastrointest Liver Physiol** 309, G602-607 \* **corresponding author**
12. Priyamvada S, Anbazhagan AN, Gujral T, **Borthakur A**, Saksena S, Gill RK, Alrefai WA, Dudeja PK (2014). All-trans retinoic acid increases SLC26A3 (DRA) function and expression in intestinal epithelial cells via HNF-1  $\beta$ . **J Biol Chem** 290, 15066-77
13. Kumar A, Hecht C, Priyamvada S, Anbazhagan AN, Alakkam A, **Borthakur A**, Alrefai WA, Gill RK, Dudeja PK (2014) Probiotic Bifidobacterium species Stimulate Human SLC26A3 Gene Function and Expression in Intestinal Epithelial Cells. **Am J Physiol Cell Physiol** 307, C1084-1092
14. Singh V, Kumar A, Raheja G, Anbazhagan AN, Priyamvada S, Saksena S, Gill RK, Alrefai WA, **Borthakur A**, Dudeja PK (2014). *Lactobacillus acidophilus* attenuates dysregulation of DRA function and expression in inflammatory models. **Am J Physiol Gastrointest Liver Physiol**. 307, G623-631
15. Anbazhagan AN, Priyamvada S, Kumar A, Maher DB, **Borthakur A**, Alrefai, WA Malakooti J, Kwon JH, Dudeja PK (2013) Translational repression of SLC26A3 by miR-494 in intestinal epithelial cells. **Am J Physiol Gastrointest Liver Physiol**. 306, G123-131
16. **Borthakur A**, Bhattacharyya S, Kumar A, Tobacman JK, Dudeja PK (2013) *Lactobacillus acidophilus* alleviates platelet activating factor-induced inflammatory responses in intestinal epithelial cells. **PLoS One** 8, e75664 \***corresponding author**
17. **Borthakur A**, Priyamvada S, Kumar A, Gill RK, Alrefai WA and Dudeja PK (2012) A novel nutrient sensing mechanism underlies substrate-induced regulation of Monocarboxylate transporter 1. **Am J Physiol Gastrointest Liver Physiol** 303,G1126-G1133 \***corresponding author**
18. Singh V, Raheja G, **Borthakur A**, Kumar A, Gill RK, Alakkam A, Malakooti J, Dudeja PK (2012) *Lactobacillus acidophilus* up-regulates intestinal NHE3 expression and function. **Am J Physiol Gastrointest Liver Physiol** 303, G1393-G1401
19. **Borthakur A**, Bhattacharyya S, Anbazhagan AN, Dudeja PK, Tobacman JK (2012) Sustained inflammation in response to carrageenan exposure in colonic epithelial cells attributed to activation of NF- $\kappa$ B-Bcl10 loop. **Biochim Biophys Acta** (Molecular basis of Disease) 1822,1300-1307
20. Annaba F, Sarwar Z, Saksena S, Gill RK, **Borthakur A**, Hecht GA, Dudeja PK and Alrefai WA (2012) Enteropathogenic *Escherchia coli* (EPEC) Inhibits Ileal

Sodium-Dependent-Bile Acid Transporter ASBT. **Am J Physiol Gastrointest Liver Physiol**, 302,G1216-1222

21. Bhattacharyya S, **Borthakur A**, Anbazhagan AN, Dudeja PK and Tobacman JK (2011) Specific effects of Bcl10 serine mutations on phosphorylations in canonical and non-canonical pathways of NF- $\kappa$ B activation following carrageenan. **Am J. Physiol Gastrointest Liver Physiol** 301, G475-G486
22. **Borthakur A**, Anbazhagan AN, Kumar A, Raheja G, Singh V, Ramaswamy K, Dudeja PK (2010) The Probiotic *Lactobacillus plantarum* counteracts TNF- $\alpha$ -induced down-regulation of SMCT1 expression and function. **Am J Physiol Gastrointest Liver Physiol** 299, G928-934 \* **corresponding author**
23. **Borthakur A**, Bhattacharyya S, Alrefai WA, Ramaswamy K, Tobacman, JK and Dudeja PK (2010) Platelet activating factor-induced NF- $\kappa$ B activation and IL-8 production in intestinal epithelial cells are Bcl10 dependent. **Inflammatory Bowel Diseases** 16, 593-603 \***corresponding author**
24. Bhattacharyya S, **Borthakur A**, Dudeja PK, Tobacman JK (2010) Lipopolysaccharide-induced activation of NF- $\kappa$ B non-canonical pathway requires Bcl10 Serine 138 and NIK phosphorylations. **Exptl Cell Res** 316, 3317-3327
25. Bhattacharyya S, **Borthakur A**, Tyagi S, Gill RK, Chen M, Dudeja PK and Tobacman JK (2010) Bcl10 is required for NF- $\kappa$ B activation by both canonical and non-canonical pathways and for NF- $\kappa$ B-inducing kinase (NIK) phosphorylation. **J. Biol. Chem.** 285, 522-530
26. Raheja G, Singh S, Ma K, Boumendjel R, **Borthakur A**, Gill RK, Saksena S, Alrefai WA, Ramaswamy, K, Dudeja PK (2010) *Lactobacillus acidophilus* stimulates the expression of SLC26A3 via a transcriptional mechanism. **Am J Physiol Gastrointest Liver Physiol** 298, G395-401
27. Esmaili A, Nazir SF, **Borthakur A**, Yu D, Turner JR, Saksena S, Singla A, Hecht GA, Alrefai WA, and Gill RK (2009) Enteropathogenic E. coli inhibits intestinal serotonin transporter (SERT) function and expression. **Gastroenterology** 137, 2074-2083
28. Barkinge JL, Gudi R, Sarah H, Chu F, **Borthakur A**, Prabhakar BS, and Prasad KV (2009) The p53-induced Siva-1 plays a significant role in cisplatin-mediated apoptosis. **J. Carcinog.** 8, 1-8
29. Bhattacharyya S, **Borthakur A**, Dudeja PK and Tobacman JK (2008) Food additive carrageenan induces cell cycle arrest in human intestinal epithelial cells in vitro. **J. Nutr.**, 138.469-75
30. Tobacman JK, Bhattacharyya S, **Borthakur A**, and Dudeja PK (2008) The carrageenan diet: Not recommended. **Science** 321, 1040-1041.
31. Saksena S, Dwivedi A, Singla A, Gill RK, Tyagi S, **Borthakur A**, Alrefai WA, Ramaswamy K, Dudeja PK (2008) Characterization of the 5'-flanking region and

- regulation of expression of human anion exchanger SLC26A6. **J Cell Biochem.** 105,454-66
32. **Borthakur A**, Gill RK, Tyagi S, Koutsouris A, Alrefai WA, Hecht GA, Ramaswamy K and Dudeja PK (2008) The probiotic *Lactobacillus acidophilus* stimulates Cl<sup>-</sup>/OH<sup>-</sup> exchange activity in human intestinal epithelial cells. **J. Nutr.** 138, 1355-1359
  33. **Borthakur A**, Saksena S, Gill RK, Alrefai, WA, Ramaswamy K, and Dudeja, PK (2008) Regulation of monocarboxylate transporter 1 (MCT1) promoter by butyrate in human intestinal epithelial cells: Involvement of NF- $\kappa$ B pathway. **J Cell Biochem** 103, 1452-1463
  34. Gill RK, **Borthakur A**, Hodges K, Zaheer, A, Turner, JR, Hecht GA, Ramaswamy, K, and Dudeja PK (2007). Mechanisms underlying inhibition of intestinal apical Cl<sup>-</sup>/OH<sup>-</sup> exchange following infection with enteropathogenic *E. coli*. **J. Clinical Invest**, 117, 428-37
  35. Bhattacharyya S, **Borthakur A**, Pant, N, Dudeja, PK and Tobacman, JK (2007) BCL-10 induces lipopolysaccharide induced activation of NF- $\kappa$ B and IL-8 in human intestinal epithelial cells. **Am. J. Physiol. Gastrointest Liver Physiol** 293, G429-G437.
  36. **Borthakur A**, Bhattacharyya S, Dudeja PK and Tobacman JK (2007) Carrageenan induces interleukin-8 production through distinct BCL-10 pathway in normal human intestinal epithelial cells. **Am. J. Physiol. Gastrointest Liver Physiol**, 292, G829-38
  37. Bhattacharyya S, **Borthakur A**, Dudeja PK, and Tobacman JK (2007) Carrageenan reduces bone morphogenic protein 4 (BMP-4) and activates Wnt/Beta-catenin pathway in normal human colonocytes. **Dig.Dis.Sci.** 52, 2766-2774
  38. **Borthakur A**, Gill RK, Hodges K, Ramaswamy K, Hecht G, and Dudeja PK (2006) Enteropathogenic *E. coli* inhibits butyrate uptake in Caco-2 cells by altering apical membrane MCT1 level. **Am J Physiol Gastrointest Liver Physiol** 290, G-30-G-35
  39. Hadjiagapiou C, **Borthakur, A\***, Dahlal R, Gill RK, Malakooti, J, Ramaswamy, K and Dudeja, PK (2005) Role of USF1 and USF2 as potential repressor proteins for human monocarboxylate transporter 1 promoter. **Am. J. Physiol. Gastrointest Liver Physiol.** 288, G1118-G1126 \* **co-first author**
  40. Chu, F., **Borthakur, A\***, Sun, X., Barkinge, J. and Prasad, K.V.S. (2004) An amphipathic helical region in Siva-1 (SAH) is sufficient to bind to BCL-XL and sensitise cells to UV radiation induced apoptosis. **Apoptosis**, 9, 83-95 \* **co-first author**
  41. Xue, L., Chu, F., Cheng, Y., Sun, X., **Borthakur, A.**, Ramarao, M., Pandey, P., Wu, M., Schlossman, S.F. and Prasad, K.V.S. (2002) Siva-1 binds to and inhibits



BCL-XL mediated protection against UV radiation induced apoptosis. **Proc. Natl. Acad. Sci. USA**, 99,6925-6930

42. Verma, N.K., **Borthakur, A.** and Deka, P.C. (2001) Rapid micropropagation of two economically important banana cultivars of North East India. **Ind. J. Hill Farming**, 13, 233-236
43. Edwards, A., **Borthakur, A.**, Bornemann, S., Venail, J., Denyer, K., Waite, D., Fulton, D., Smith, A. and Martin, C. (1999) Specificity of starch synthase isoforms from potato. **Eur. J. Biochem.**, 266,724-736
44. Borthakur, S., Mandal, T.K., **Borthakur, A.** and Deka, P.C. (1998) Isolation of chloroplast DNA from tea (*Camellia* spp.). **Indian J. Exptl. Biol.**, 36,1165-1167
45. Shasani, A.K., Suman, B. and **Borthakur A** (1997) Microbial degumming of ramie (*Boehmeria nivea*) **Indian J Microbiol.**34, 267-270
46. Goswami, B. and **Borthakur, A\***. (1996) Chemical and biochemical aspects of developing culinary banana (*Musa ABB*) **Food Chemistry**, 55, 169-172 \*  
**Corresponding author**
47. Borthakur S., Mandal T.K., **Borthakur A.** and Deka, P.C. (1995) Variation in peroxidase and esterase isozymes in tea leaves. **Two and a Bud**, 42, 14-19
48. **Borthakur, A.**, Appu Rao, A.G. and Ramadoss, C.S. (1990) Bengal gram lipoxygenase: Fluorescence quenching study of the interaction of the interaction of linoleic acid and 13- and 9- hydroperoxylinoleic acid with two forms of the enzyme. **J. Agric. Food Chem.**, 38, 1487-1490
49. **Borthakur, A.**, Appu Rao, A.G. and Ramadoss, C.S. (1988) Physico-chemical studies on two forms of Bengal gram lipoxygenase: Implications for structural differences **Biochim.et. Biophys. Acta**, 958, 40-51
50. Ramadoss, C.S., Shenoy, B.C. and **Borthakur, A.** (1987) Isolation and characterization of a novel haemoprotein b559 from Bengal gram. **Biochem. J.**, 243, 723-728
51. **Borthakur, A.**, Bhat, B.G. and Ramadoss, C.S. (1987) Positional specificities of oxygenation of linoleic acid by two forms of Bengal gram lipoxygenase. **J. Biosci.**, 11, 257-263
52. **Borthakur, A.** and Ramadoss, C.S. (1986) Aerobic formation of ketodiene from linoleic acid by one of the two forms of lipoxygenase isolated from Bengal gram. **J. Agric. Food. Chem.**, 34, 1016-1018
53. Sukhija, P.S., **Borthakur, A.** and Bhatia, I.S. (1980) Effect of irrigation on lipid biosynthesis in developing sunflower seeds. **J. Sci. Food Agric.**, 31, 225-228
54. Sukhija, P.S., **Borthakur, A.** and Bhatia, I.S. (1980) Lipid composition of different zones of the sunflower head during development. **Biochem. Physiol. Pflanzen**, 175, 481-484

## **BOOK CHAPTERS**

1. Singh, S., **Borthakur, A.** and Deka, P.C. (2001) Molecular Markers: Techniques and Applications. In: **Biotechnology of Horticultural Crops**, T.K.Bose (ed.), Naya Prakash Publications, Calcutta, India, pp 35-59
2. Gill RK, Alrefai WA, **Borthakur A**, Dudeja PK (2012) Intestinal Anion Absorption: In **Physiology of the Gastrointestinal Tract, Volume II** Eds. Johnson LR, Burlington MA, pp 1819-1847
3. Kumar A, Bhat P, **Borthakur A**, Alrefai WA and Dudeja PK (2018) Mechanisms Underlying Beneficial Role of Probiotics in Diarrheal Diseases: Host-Microbe Interactions. In **Mechanisms Underlying Host-Microbiome Interactions in Pathophysiology of Human Diseases**, The American Physiological Society, J. Sun, P.K. Dudeja (eds.), Physiology in Health and Disease, pp 89-111, [https://doi.org/10.1007/978-1-4939-7534-1\\_5](https://doi.org/10.1007/978-1-4939-7534-1_5)