



Clay Swackhamer CV

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CURRENT ROLE

Purdue University

2022-present

Position: Postdoctoral Researcher

Department: Food Science

Supervisor: [Dr. Bruce Hamaker](#)

Project: USDA-NIFA postdoctoral fellowship (2 years) to investigate the effect of dietary fiber structure on the taxonomic composition of the gut microbiome.

EDUCATION

University of California, Davis

Ph.D. 2022

Major: Biological Systems Engineering

Minor: Modeling and Control of Biological Systems

Specialization: Food Engineering

Supervisor: [Dr. Gail Bornhorst](#)

Project: Designing model, solid foods with macronutrient composition based on the Standard American Diet but with varying rates of softening to study the mechanisms of solid food breakdown during in vitro gastric digestion with simulated peristalsis.

GPA: 3.94

Penn State University

B.S. 2015

Major: Biological Engineering

Minor: Spanish

Specialization: Food and Biological Process Engineering

Schreyer Honors College Scholar

GPA: 3.92

University of Alicante

Fall 2014

Semester abroad in Alicante, Spain

Completed 15 credits taught in Spanish, including a microbiology course with a laboratory

GPA: 4.00

PEER-REVIEWED PUBLICATIONS

1. **C. Swackhamer**, T. Bedane, S. Keppler, A. Poltorak, K. Cheung, N. Awais, F. Marra, G. Bornhorst, "Development and Analysis of a Multi-Module Peristaltic Simulator for Gastrointestinal Research." 2023. Food Research International. 112877. [10.1016/j.foodres.2023.112877](https://doi.org/10.1016/j.foodres.2023.112877).
2. **C. Swackhamer**, R. Doan*, G. Bornhorst, "Development and characterization of standardized model, solid foods with varying breakdown rates during gastric digestion." 2022. Journal of Food Engineering. 316:110827. [10.1016/j.jfoodeng.2021.110827](https://doi.org/10.1016/j.jfoodeng.2021.110827).
3. Y. Mennah-Govela, **C. Swackhamer**, G. Bornhorst, "Gastric secretion rate and protein concentration impact intragastric pH and protein hydrolysis during dynamic in vitro gastric digestion." 2020. Food Hydrocolloids for Health. [10.1016/j.fhfh.2021.100027](https://doi.org/10.1016/j.fhfh.2021.100027).

4. **C. Swackhamer**, J. Mullin, “Emergency Transition of Intro Communication and Design Course to Remote Teaching.” 2021. American Society of Engineering Education Conference.
<https://doi.org/10.18260/1-2-37025>. **Won best paper award in Design in Engineering Education Division: Award announcement.**
5. A. Hayes, F. Gozzi, A. Diatta, T. Gorissen, **C. Swackhamer**, S. Bellmann, B. Hamaker, “Some pearl millet-based foods promote satiety or reduce glycaemic response in a crossover trial.” 2020. British Journal of Nutrition. [10.1017/S0007114520005036](https://doi.org/10.1017/S0007114520005036).
6. N. Nativ-Zeltzer, R. Ueha, Y. Nachalon, B. Ma, G. Pastenkos, **C. Swackhamer**, G. Bornhorst, M. Lefton-Greif, J. Anderson, P. Belafsky. “Inflammatory Effects of Thickened Water on the Lungs in a Murine Model of Recurrent Aspiration.” 2020. The Laryngoscope. [10.1002/lary.28948](https://doi.org/10.1002/lary.28948).
7. A. Hayes, **C. Swackhamer**, Y. Mennah-Govela, M. Martínez, A. Diatta, G. Bornhorst. B. Hamaker. “Pearl millet (*Pennisetum glaucum*) couscous breaks down faster than wheat couscous in the Human Gastric Simulator, though has slower starch hydrolysis.” 2020. Food & Function. 11: 111-122.
[10.1039/C9FO01461F](https://doi.org/10.1039/C9FO01461F). **Selected as cover article, created original art for journal cover using Adobe Illustrator:** <https://pubs.rsc.org/en/content/articlelanding/2020/fo/d0fo90003f>.
8. **C. Swackhamer**, Z. Zhang, A. Taha, G. Bornhorst. “Fatty acid bioaccessibility and structural breakdown from in vitro digestion of almond particles.” 2019. Food & Function. 10: 5174-5187.
[10.1039/C9FO00789J](https://doi.org/10.1039/C9FO00789J)
9. **C. Swackhamer**, G. Bornhorst. “Fracture properties of foods: Experimental considerations and applications to mastication.” 2019. Journal of Food Engineering. 263: 213-226.
[10.1016/j.jfoodeng.2019.07.002](https://doi.org/10.1016/j.jfoodeng.2019.07.002)
10. D. Ciolkosz, R. Hilton, **C. Swackhamer**, H. Yi, V. Puri, D. Swomley, G. Roth, “Farm-scale biomass pelletizer performance for switchgrass pellet production.” 2015. Applied Engineering in Agriculture. 31(4): 559-567. [10.13031/aea.31.10803](https://doi.org/10.13031/aea.31.10803)

* undergraduate student mentored

SUBMITTED MANUSCRIPTS

1. F. Cisse[†], **C. Swackhamer**[†], H. Dially, A. Rahmanifar, M. Sylla, A.R. Opekun, M.A. Grusak, A. H-M. Lin, E.A. Pletsch, A. M.R. Hayes, R. Quezado-Calvillo, B.L. Nichols, B. R. Hamaker, “Stunted African toddlers digest and obtain energy from energy-dense thick sorghum porridge.” 2024. Submitted to European Journal of Clinical Nutrition.
2. A. Hayes[†], **C. Swackhamer**[†], R. Quezado-Calvillo, N.F. Butte, E.E. Sterchi, B.L. Nichols, B.R. Hamaker “Moderating carbohydrate digestion rate promotes metabolic flexibility in mice.” Submitted to European Journal of Nutrition. [Preprint on bioRxiv](#)

[†]co-first authors

RESEARCH SUPPORT

Current support

1. **USDA-NIFA postdoctoral research fellowship** for two year time period for proposal titled “Effect of fiber structure on the taxonomic composition of the colonic microbiome.” *August 2022-August 2024*. \$190,000. [Award information](#).

Past support

1. **UC Davis Jastro-Shields Fellowship** for graduate students in agricultural or environmental sciences based on competitive application for original research. Proposal title: “Influence of mechanical properties on the particle breakdown dynamics of standard, model solid foods during in vitro gastric digestion using a peristaltic simulator.” \$1,000. *July 2021.*
2. **UC Davis Jastro-Shields Fellowship** for graduate students in agricultural or environmental sciences based on competitive application for original research. Proposal title: “Breakdown of model solid foods based on the Standard American Diet using shear and fracture testing diet to quantify mechanical breakdown during in vitro gastric digestion.” \$3,000. *September 2020.*
3. **UC Davis Graduate Student Travel Award** \$500. *May 2020.*
4. **Biological Systems Engineering Graduate Program Fellowship Award** \$2,000. *May 2020.*
5. **Walter Rosenburg Research Fund** to support the research of PhD candidates in Biological and Agricultural engineering, based on faculty nomination \$2,000. *May 2020.*
6. **John C. Harper Memorial Fellowship** for graduate students in Biological Systems Engineering specializing in Food Engineering, based on faculty nomination \$3,500. *November 2019.*
7. **UC Davis Jastro-Shields Fellowship** for graduate students in agricultural or environmental sciences based on competitive application for original research. Proposal title: “Development and mechanical property testing of a novel system of test foods for studying food breakdown during in vitro gastric digestion.” \$2,500. *July 2019.*
8. **UC Davis Jastro-Shields Fellowship** for graduate students in agricultural or environmental sciences based on competitive application for original research. Proposal title: “Development and validation of a low-cost, single camera calibrated computer vision system for particle size analysis of foods subjected to in vitro digestion.” \$2,000. *October 2018.*
9. **UC Davis Jastro-Shields Fellowship** for graduate students in agricultural or environmental sciences based on competitive application for original research. Proposal title: “Characterizing the influence of physical properties on lipid release from fractured almonds using simulated gastric digestion.” \$1,700. *October 2017.*
10. **UC Davis Mentoring at Critical Transitions Award** for graduate students based on competitive application and potential to transition to future role as mentor, \$3,000. *September 2017.*
11. **UC Davis Scholars Award** first year fellowship for outstanding graduate students at UC Davis, \$58,000. *September 2016.*

PREPRINTS AND PROJECT REPORTS

1. **C. Swackhamer** “Re-analysis of Environmental fluctuations reshape an unexpected diversity-disturbance relationship in a microbial community.” 2023. Project report for course ANSC 516 (Molecular microbiome analysis) in the Department of Animal Science at Purdue University. [PDF on Github](#)
2. **C. Swackhamer**, “Solving the heat equation for a slice of pie using Green’s functions.” 2017. Project report for course ECH 259 (Advanced engineering mathematics) in the Department of Chemical Engineering at UC Davis. [PDF on Github](#).
3. **C. Swackhamer**, “Effect of codon optimization on bacterial translation elongation rates.” 2015. Undergraduate honors thesis in the Department of Biological and Agricultural Engineering at Penn State. [PDF on Github](#).

INDUSTRY EXPERIENCE

Engineering intern

Winter-Summer 2016

LignoLink, INC.
Innovation Park, PA

- Conducted aqueous ammonia pretreatment and enzymatic hydrolysis reactions on 98 biomass samples (corn stover)
- Designed, constructed, and validated High Performance Liquid Chromatography (HPLC) assay for 5 sugar monomers in hydrolyzed biomass samples
- HPLC development included equipment selection, purchase, installation, calibration, and development of semi-automated data analysis routine using MATLAB
- Created the first logo and website for a faculty-led startup company, funded by the National Science Foundation-Small Business Innovation Research (NSF-SBIR) program
- Information about the company: [NSF page](#), [News article](#)

Engineering intern

Summer 2015

McCormick & Company INC, Materials Process Engineering Group
Hunt Valley, MD

- Measured physical properties of dry seasoning mixes (gravy mixes, taco seasoning, steak seasonings) using 5 instruments in food powder technology platform
- Helped create plan to achieve \$160,000 annual cost savings by reducing overblending, which can affect product bulk density and lead to overfill losses
- Conducted over 300 experiments, mostly involving powder flowability and compaction properties; processed data using descriptive statistics and modeling
- Quantified link between blend time and product bulk density
- Collaborated with McCormick engineers in 3 countries

TEACHING EXPERIENCE

Short course instructor

October 2023

Module title: “Computational Approaches to Big Data in Gut Microbiome Studies”
Whistler Center for Carbohydrate Research Annual Short Course
Purdue University Department of Food Science

- Co-designed a short course module with Dane Deemer, Dr. Bruce Hamaker, and Dr. Stephen Lindemann
- Developed instructional materials including a (hopefully fun) demonstration using a deep convolutional neural network for image classification of hand-drawn artwork submitted by Whistler Center members
- Taught the first half of the module (45 min)
- Helped answer questions from industry members (about 25 individuals attended the module)

Teaching assistant *Spring 2019, Fall 2019, Winter 2020, Spring 2020, Fall 2020, Winter 2021, Spring 2021, Fall 2021, Winter 2022*

Course ENG 003: Intro to Engineering Design
UC Davis College of Engineering

- Responsible for two lab sections every academic quarter (ca. 22 students each)
- Served as a teaching assistant for 9 quarters, thus working with about 400 students in total
- Taught basics of circuit building using Arduino and Raspberry Pi
- Topics included circuit prototyping on breadboards, writing Arduino and python code, interfacing with analog devices, and troubleshooting circuits using a multimeter

- Built circuits to interface with sensors measuring temperature, weight, light, moisture, color, humidity, dust level, carbon dioxide concentration, pH, and water flow rate
- Built circuits to interface with devices such as servo motors, DC motors, solenoid valves, Raspberry Pi camera
- Taught engineering design topics including the iterative process of design, prototyping, decision matrices, and effective presentation techniques
- Directly advised ca. 90 student teams as they created original design projects
- Participated in the emergency transition of this highly in-person course to remote teaching in the spring of 2020 during the COVID-19 pandemic. Helped conduct research on student learning outcomes using a validated survey instrument. Published peer-reviewed paper on our findings at the American Society of Engineering Education conference and won the best paper award in the division. [Award announcement](#).

Teaching assistant

Fall 2018

Course EBS 001: Foundations of Biological Systems Engineering
UC Davis Department of Biological and Agricultural Engineering

- Provided written feedback for 49 students on homeworks and exams
- Held weekly office hours
- Supervised construction of seven algae photobioreactors and seven solar food dehydrators made by student teams for their final project

Teaching intern

Fall 2015

Course BE 301: Mathematical Modeling of Biological and Physical Systems
Penn State Department of Agricultural and Biological Engineering

- Teaching intern for course BE 301: Mathematical Modeling of Biological and Physical Systems (approximately 20 students)
- Held weekly office hours
- Ran review sessions and helped troubleshoot student MATLAB codes

PRESENTATIONS

1. **C. Swackhamer**. “Effect of fiber structure on the taxonomic composition of the colonic microbiome.” Oral presentation. USDA project directors’ meeting. *May 2024*.
2. **C. Swackhamer**. T. Cantu-Jungles. B. Hamaker. “Three patterns emerge in the gut microbial community during in vitro fecal fermentation of dietary fibers varying in their level of complexity.” Poster presentation. Midwest Microbiome Symposium. *May 2024*.
3. **C. Swackhamer**. “Engineering all along the digestive tract: model foods with designer breakdown kinetics, multiphysics CFD modeling, and microbiome engineering.” Oral presentation. Michigan State University Department of Biosystems and Agricultural Engineering Seminar. *March 2024*.
4. **C. Swackhamer**. “Effect of Arabinoxylan Structure on the Microbiota during in vitro Fecal Fermentation.” Oral presentation. Whistler Center for Carbohydrate Research Update Seminar Series. Purdue Department of Food Science. *September 2023*.
5. **C. Swackhamer**. “Artificial Intelligence in Microbiome Research: Concepts and Applications to the Food Industry.” Oral presentation. Whistler Center for Carbohydrate Research Annual Meeting Technical Workshop. Purdue Department of Food Science. *May 2023*.
6. **C. Swackhamer**. B. Hamaker. “Project update: Effect of fiber structure on the taxonomic composition of the colonic microbiome.” Poster presentation. Whistler Center for Carbohydrate Research Annual Meeting. Purdue Department of Food Science. *May 2023*.

7. **C. Swackhamer**, R. Doan*, G. Bornhorst. "Breakdown Mechanisms of Model Solid Foods During in Vitro Gastric Digestion with Simulated Peristalsis." Oral presentation. Conference of Food Engineering. *September 2022*.
8. **C. Swackhamer**, R. Doan*, G. Bornhorst. "Food physical properties influence mechanisms of particle breakdown of solid foods during in vitro gastric digestion in the Human Gastric Simulator." Poster presentation. Institute of Food Technologists Conference. *July 2022*.
9. **C. Swackhamer**, "Breakdown of solid foods during in vitro gastric digestion." PhD exit seminar in UC Davis Department of Biological and Agricultural Engineering. *January 2022*.
10. **C. Swackhamer**, J. Mullin "Emergency Transition of Intro Communication and Design Course to Remote Teaching." Remote/virtual oral presentation. American Society of Engineering Education Conference. **Won best paper award in the division.** [Award announcement](#). *July 2021*.
11. **C. Swackhamer**, R. Doan*, G. Bornhorst. "Fracture property analysis of standardized, model solid foods during in vitro gastric digestion." Remote/virtual poster presentation. Institute of Food Technologists Conference. *July 2021*.
12. R. Doan*, **C. Swackhamer**, G. Bornhorst. "Buffering capacity of standard model foods as related to simulated gastric digestion." Virtual Poster Presentation. UC Davis Undergraduate Research Conference. Davis, CA, *April 2021*.
13. **C. Swackhamer**, S. Keppler, A. Poltorak, T.F. Bedane, K. Cheung, N. Awais, F. Marra, G. Bornhorst. "Video analysis and computational fluid dynamic modeling of a novel multi-module peristaltic simulator for gastrointestinal research." Remote/virtual poster presentation. Institute of Food Technologists Conference. **Won first place in Food Engineering Division graduate student research poster competition.** *July 2020*. [Award announcement](#).
14. **C. Swackhamer**, R. Doan*, G. Bornhorst. "Development and characterization of standardized model, solid foods with varying breakdown rates during gastric digestion." Remote/virtual poster presentation. Institute of Food Technologists Conference. *July 2020*.
15. Z. Fu*, **C. Swackhamer**, G. Bornhorst. "Effect of simulated gastric juice on texture change of almond particles during simulated gastric digestion." Poster Presentation. UC Davis Undergraduate Research Conference. Davis, CA, *April 2019*.
16. **C. Swackhamer**, Z. Zhang, A. Taha, G. Bornhorst. "Fatty acid bioaccessibility, structural breakdown, and properties of digesta from in vitro digestion of almond particles." Poster Presentation. Conference of Food Engineering. Minneapolis, MN, *September 2018*.
17. A. Hayes, **C. Swackhamer**, M. Martínez, Y. Mennah-Govela, G. Bornhorst, B. Hamaker. "Breakdown rate of couscous made from pearl millet versus wheat in a simulated gastric environment linked to gastric emptying." Poster Presentation. Institute of Food Technologists Conference. Chicago, IL, *July 2018*.
18. X. Cao*, **C. Swackhamer**, G. Bornhorst. "Experimental investigation of the impact of processing variables on fracture properties of almonds." Poster Presentation. UC Davis Undergraduate Research Conference. Davis, CA, *April 2018*.
19. A. Hayes, **C. Swackhamer**, M. Martínez, Y. Mennah-Govela, G. Bornhorst, B. Hamaker. "Insights to the delayed gastric emptying rate and slow digestibility of pearl millet couscous." Poster Presentation. Sorghum in the 21st Century. Cape Town, South Africa, *April 2018*.
20. A. Olenskyj, Y. Mennah-Govela, **C. Swackhamer**, K. Rios-Villa, G. Bornhorst. "Softening half-time and final normalized hardness as indicators of food structural breakdown during in vitro digestion." Poster Presentation. Institute of Food Technologists Conference. Las Vegas, NV, *June 2017*.

21. **C. Swackhamer**, Y. Mennah-Govela, G. Bornhorst. "Physical property changes in soaked and activated almonds." Poster Presentation. Almond Board of California Conference. Sacramento, CA, *December 2016*.
22. **C. Swackhamer**. "Effect of codon optimization on bacterial translation elongation rates." Presentation. Penn State Department of Agricultural and Biological Engineering Department seminar: Exit seminar for undergraduate honors thesis presentation. University Park, PA, *December 2015*.
23. **C. Swackhamer**, "Industrial batch fermentation of L-Lysine using *Corynebacterium glutamicum*." Presentation. Northeast Agricultural and Biological Engineering Conference (ASABE regional conference), Newark, DE, *July 2015*.
24. **C. Swackhamer**, A. Smith, E. Sileo, S. Krug, "Next-generation approaches to overcome the challenges of metabolic pathway engineering." Presentation. iGEM Giant Jamboree, Boston, MA, *October 2014*.
25. **C. Swackhamer**, B. Wright, "Small scale densification of *Panicum virgatum* through pelletization." Poster Presentation. Northeast Agricultural and Biological Engineering Conference (NABEC), Altoona, PA, *July 2013*.
26. **C. Swackhamer**, B. Wright, "Small scale densification of *Panicum virgatum* through pelletization." Poster Presentation. Penn State Undergraduate Research Exposition, University Park, PA, *April 2013*.
27. **C. Swackhamer**, V. Vadyak, N. Vitacco. A. Alsuwaidi, "Portable recharging system for personal electronic devices." Poster Presentation. Penn State Engineering Design Showcase, University Park, PA, *December 2012*.

* indicates undergraduate researcher mentored

AWARDS

1. **Best paper award** in Design in Engineering Education Division at American Society of Engineering Education Conference. *July 2021*. [Award announcement](#).
2. **Best teaching assistant award 2020**. Department of Biological and Agricultural Engineering, UC Davis College of Engineering. *August 2020*. [Award announcement](#).
3. **First place in graduate student research poster competition**. Food Engineering Division. Institute of Food Technologists Conference. *July 2020*. [Award announcement](#).
4. **Outstanding Senior Award** in Penn State Department of Biological and Agricultural Engineering. *May 2016*.
5. **First place** in undergraduate paper competition for presentation of "Industrial Batch Fermentation of L-Lysine using *Corynebacterium glutamicum*." Northeast Agricultural and Biological Engineering Conference (NABEC). *July 2015*.
6. **Gold medal** for team presentation of "Next-Generation Approaches to Overcome the Challenges of Metabolic Pathway Engineering." iGEM Giant Jamboree. *October 2014*.
7. **Myriant Corporation Scholarship** for Excellence in Bioenergy. *October 2013*.
8. **Third place award** in engineering division for poster presentation of "Small Scale Densification of *Panicum virgatum* through Pelletization." Penn State Undergraduate Research Exposition. *April 2013*.
9. **"Best in class" award** for poster presentation of "Portable Recharging System for Personal Electronic Devices." Penn State Engineering Design Showcase. *December 2012*.

CERTIFICATIONS

1. **Professional Engineer (PE)**. Agricultural engineer registered with California Board for Professional Engineers, Land Surveyors, and Geologists. License number 589. *2022*.
2. **Biosafety for Principal Investigators, Lab Personnel, and IBC Members**. Two hour course with quiz and certificate, developed by the Collaborative Institutional Training Initiative (CITI). *2023*.
3. **Responsible Conduct of Research Training for Faculty, Postdoctoral, and Graduate Students**. Two hour course with quiz and certificate, developed by the Collaborative Institutional Training Initiative (CITI). *2023*.
4. **Social and Behavioral Research Best Practices for Clinical Research**. Three hour course with quiz and certificate, developed by the Collaborative Institutional Training Initiative (CITI). *2020*.
5. **Social and Behavioral Science Responsible Conduct of Research**. Three hour course with quiz and certificate, developed by the Collaborative Institutional Training Initiative (CITI). *2020*.
6. **Proposal Writing Program: Writing Successful Grant Proposals**. Five hour professional development program with quiz and certificate, developed by the American Association for the Advancement of Science (AAAS). *2017*.
7. **Synthetic biology certificate for undergraduates**, Synthetic Biology Engineering Research Center (SYNBERC). *2015*.
8. **Laboratory safety fundamentals** certificate, UC Davis Safety Services. *2016-present*.
9. **Passed Fundamentals of Engineering Exam** (FE-general disciplines). Certified engineer in Training (EIT), license number ET021732. *2015-present*.

PROFESSIONAL AFFILIATIONS AND LEADERSHIP

1. **Past president and co-founder**, Society of Food Engineering Student Division (*2020-2021*)
2. **Member**, Sigma Xi, The Scientific Research Honor Society (*2020-present*)
3. **Representative for UC Davis General Graduate Student Association**, Biological Engineering Graduate Student Association, UC Davis (*2019-2020*)
4. **Secretary**, Biological Engineering Graduate Student Association, UC Davis (*2018*)
5. **Member**, Society of Food Engineering (SoFE) (*2018-present*)
6. **Alumni Relations Co-Chair**, Biological Engineering Graduate Student Association, UC Davis (*2017*)
7. **Laboratory Safety Officer**, Food Engineering Laboratory, UC Davis (*Spring 2017, Spring 2019*)
8. **Member**, Institute of Food Technologists (IFT) (*2016-present*)
9. **Treasurer**, Alpha Epsilon, Honors Society of Biological Engineering, Penn State chapter (*2015*)
10. **Alumni Relations Chair**, Alpha Gamma Rho National Agricultural Sciences Fraternity (*2013-2014*)
11. **Financial Chair**, Penn State Agricultural Sciences Student Council (*2013-2014*)
12. **Member**, American Society of Agricultural and Biological Engineers (*2013-present*)
13. **Member**, Gamma Sigma Delta, National Honors Society in Agriculture (*2013-present*)

SERVICE AS PEER REVIEWER

Journal name	Number of manuscripts reviewed
Computers and Electronics in Agriculture	3
Journal of Food Science	1
Journal of Texture Studies	1
Frontiers in Nutrition	1
Applied Sciences	3
Processes	1
Fluids	1
Information	1

ONLINE PROFILES

1. Personal website: <https://clayswackhamer.com/>:
2. ORCID: <https://orcid.org/0000-0001-8155-0642>:
3. Google scholar: <https://scholar.google.com/citations?user=bv2KWioAAAAJ>
4. Researchgate: <https://www.researchgate.net/profile/Clay-Swackhamer>
5. LinkedIn: <https://www.linkedin.com/in/clay-swackhamer-6a8b29a4/>
6. Github: <https://github.com/clayswack>
7. Mathworks: <https://www.mathworks.com/matlabcentral/profile/authors/5344591>