



FEEDING QUALITY

FORUM



Where Science is Taking Us

Keith E. Belk, Professor & Head
Department of Animal Sciences
Colorado State University



Land Grant Universities



- The idea for the land-grant university arose in the middle of the 19th century. In an era of economic, social, and political turmoil, U.S. Representative Justin Morrill, a Vermont native and son of a blacksmith, proposed the notion of government land-grants to support practical public education for the working classes.
- Abraham Lincoln signed the first Morrill Act into law on July 2, 1862. Proceeds from the sale of land in each state would be invested in a perpetual endowment to support **colleges of agriculture and mechanic arts**. The signing of the second Morrill Act in 1890, the Hatch Act in 1887 (established **Agricultural Experiment Stations**), & the Smith-Lever Act of 1914 that created the **Cooperative Extension Service**, formed the basis of the land-grant model.
- The Morrill Act **enables all citizens of the U.S. to participate in the nation's economic and social progress**. After 150 years, the core values embodied in that spirit remain.

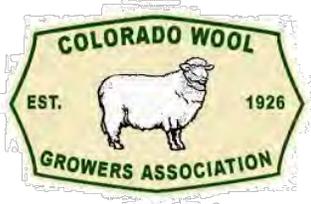


Partners



National Cattlemen's Beef Association

Cattlemen • Leadership • Solutions



COLORADO



HORSE COUNCIL



ADVANCING THE LEGACY



Rocky Mountain HORSE EXPO

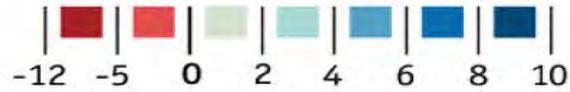


Surrogate for Meat Demand—GDP

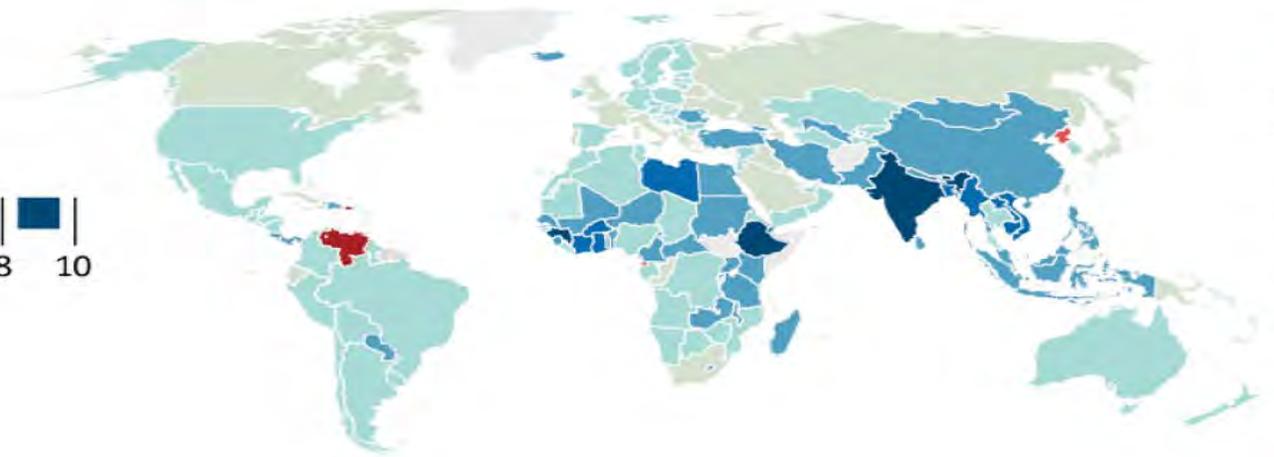
SOURCE: *The Economist*, Jan 2018

On the rise

GDP forecasts
2018, % change
on a year earlier

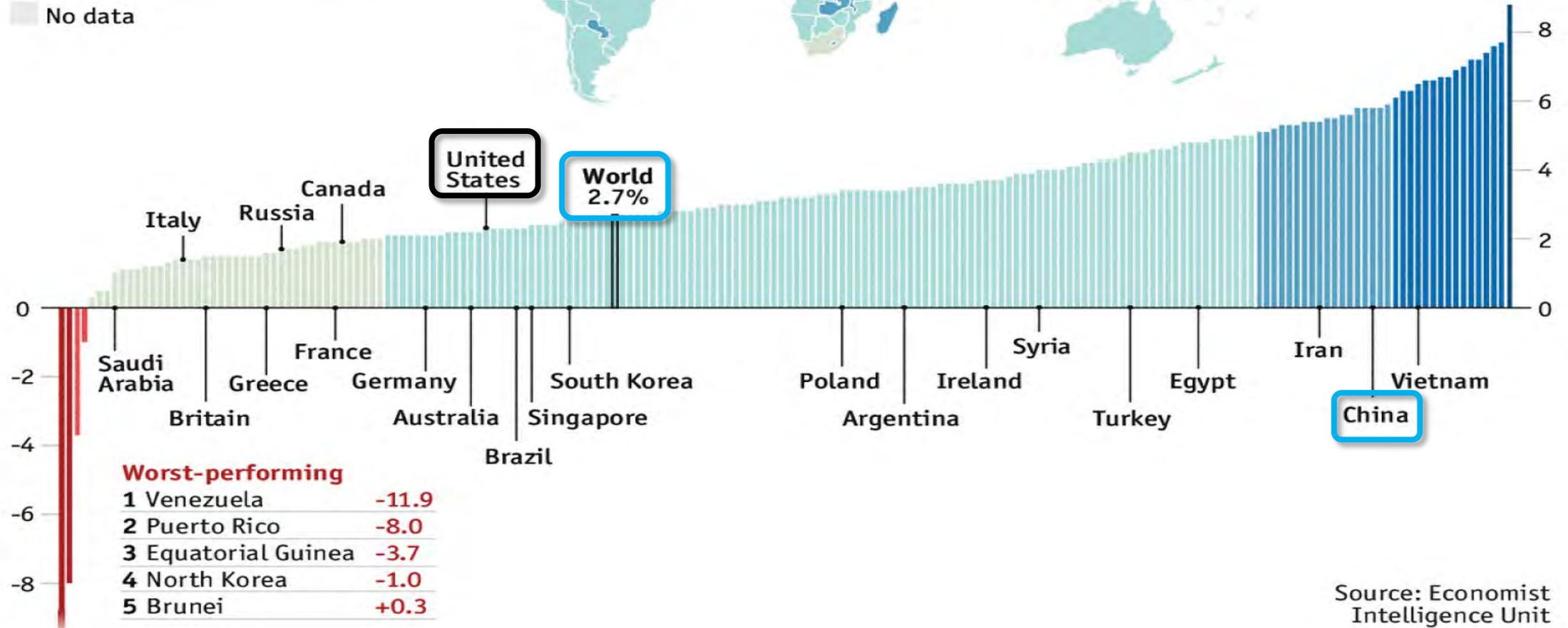


No data



Best-performing

1	Dominica	+8.8
2	India	+7.7
3	Bhutan	+7.6
4	Anguilla	+7.4
5	Ethiopia	+7.2



Worst-performing

1	Venezuela	-11.9
2	Puerto Rico	-8.0
3	Equatorial Guinea	-3.7
4	North Korea	-1.0
5	Brunei	+0.3

Source: Economist Intelligence Unit



Research at CSU (\$300 million/year)

RESEARCH

CSU is a research powerhouse consistently counted among the top performing research universities in the nation – each year for the past decade posting more than \$300 million in expenditures. A leader in areas such as atmospheric science, energy, water, veterinary and translational medicine, natural resources, chemistry, occupational therapy, and anthropology, and with ongoing and traditional strength in areas such as engineering and food production, CSU is clearly established as a premier research institution.



Leading areas:

Atmospheric Science

Energy

Water

Veterinary/Translational
medicine

Natural resources

Chemistry

Occupational Therapy

Anthropology

Engineering

Food production





Graduate School

“Graduate students today, both M.S. and Ph.D., see how hard that you are working, and they want a different life. They want larger salaries and better work-life balance. They don’t want to spend the time and energy necessary to do what you do”

Dr. Mary Stromberger

Dean of the Graduate School and Vice Provost for Graduate Affairs

Colorado State University



Coalition For Next Generation Life Science, 7-1-2018

Where will a biology PhD take you?

Arrows represent annual fluxes. Circles are total current workforce numbers.

86,000

current US biology PhD students

1,900 to 3,900 foreign-trained PhDs start postdocs

30% do more than one postdoc¹

720 leave the US

37-68,000 current postdocs

A faculty job is an "alternative" career.



At this rate, <10% of entering PhD students will become tenure-track faculty. Yet, 53% rank research professorships as their most desired career.²

15% of PhDs get tenure-track faculty jobs within 6 years post grad.²



29,000 current tenured and tenure-track faculty



17,000 current bio PhDs doing non-science jobs



22,500 current industry researchers

Every year, ~16,000 students start biology PhD programs

9,000 receive PhDs

70% (5,800) postdoc

7 years average time to degree

37% drop out

30% (2,500) don't postdoc

? years

US PhDs spend an average of 4 years, but others must spend longer to account for number of postdocs.

18% of PhDs get non-tenure track academic jobs within 6 years post grad.²

25,000 current non-tenure track academic positions



24,000 current non-research, science related jobs



7,000 current gov't researchers

10% of former postdocs (up from 2% in 2010) consider themselves unemployed.³

SOURCES:

1 - Science Careers Annual Postdoc Survey (2012) <http://goo.gl/nmVYCh>

2 - doi:10.1038/472276a <http://www.nature.com/news/2011/110420/full/472276a.html>

3 - Saurman & Roach 2012 PLoS ONE; DOI: 10.1371/journal.pone.0036307

Unless otherwise noted, NIH Biomedical Workforce Working Group (2012)

FIRST
Destination
and
Satisfaction
REPORT
2017-2018

	Plans Secured		Employed		Continuing Education ¹		Average Salary ²	Related to Career Plans		Related to Program		Offer Rate ³		Knowledge Rate ⁴	
	Count	%	Count	%	Count	%		Count	%	Count	%	Count	%	Count	%
CSU Total	1387	91%	1192	78%	195	13%	\$77,688	490	94%	1028	95%	1421	93%	1536	70%
AG	59	92%	53	83%	6	9%	\$55,520	27	96%	52	98%	61	95%	66	71%
BU	374	94%	356	90%	18	5%	\$94,216	181	92%	242	90%	383	96%	399	83%
EG	165	89%	136	73%	29	16%	\$86,671	42	98%	132	100%	169	91%	187	70%
HS	220	89%	194	78%	26	10%	\$59,860	72	97%	182	95%	225	91%	253	62%
IU	28	93%	20	67%	8	27%	--	9	100%	19	100%	28	93%	30	77%
LA	122	87%	98	70%	24	17%	\$55,235	50	94%	88	93%	127	91%	143	69%
NR	87	87%	81	81%	6	6%	\$58,124	33	92%	72	90%	91	91%	100	62%
NS	152	94%	112	70%	40	25%	\$89,016	30	100%	107	98%	154	96%	161	73%
VM	180	92%	142	72%	38	19%	\$60,051	46	94%	134	96%	183	93%	197	58%

¹ Continuing Education includes graduate, veterinary, medical, and professional school and continuing education that is not graduate school.

² Average salary is based on full-time permanent employment and continuing employment. Salary is only reported if n>4.

³ Offer rate is the percentage of graduates who are actively seeking employment or education that secured plans or indicated at least one job offer.

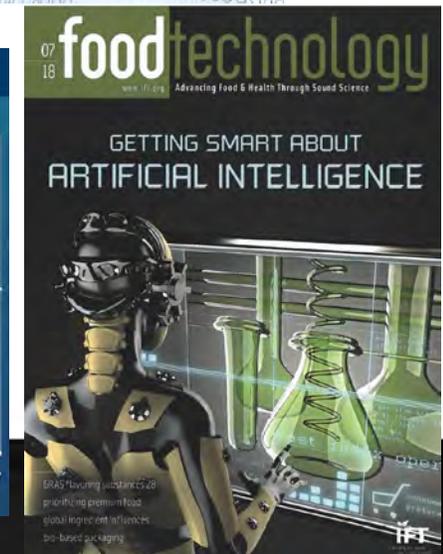
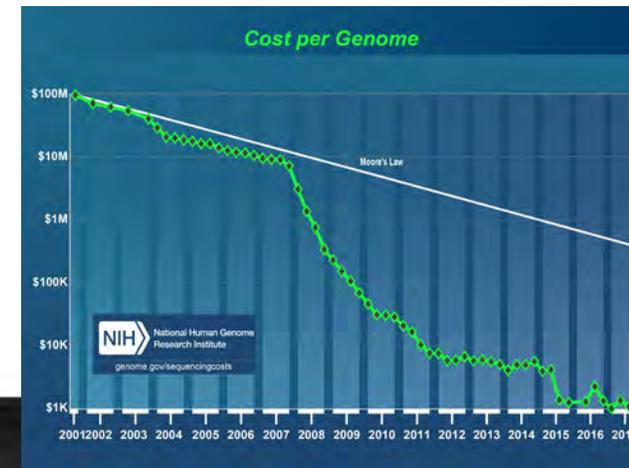
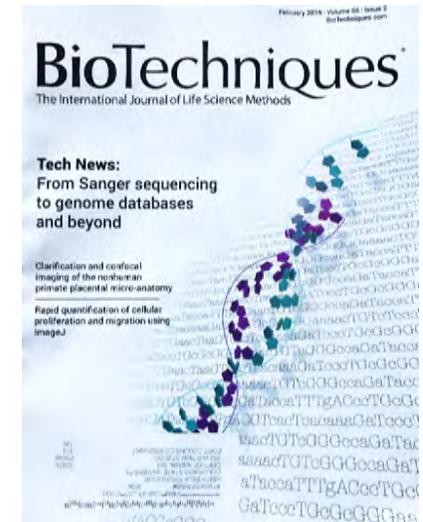
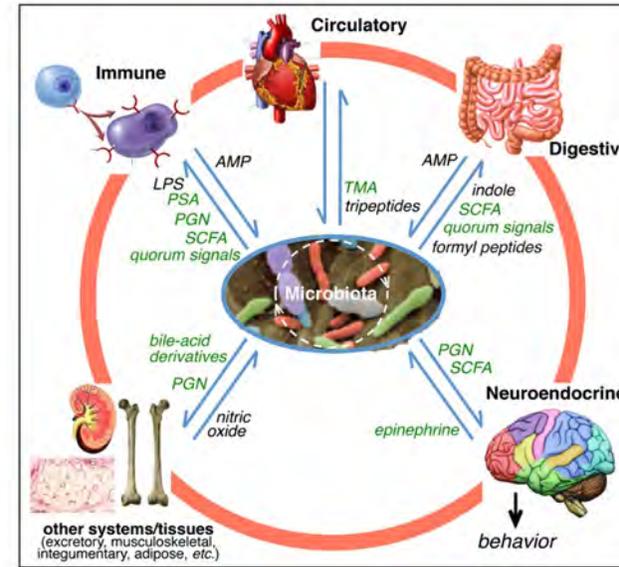
⁴ Knowledge rate is the percent of graduates for which CSU has reasonable and verifiable information regarding post-graduation plan.



Paradigm Shift In Research Methods



- Next Generation Sequencing (NGS)
- Transcriptomics
- Metabolomics
- Metagenomics
- Proteomics
- Pangenomics/Epigenomics
- Gene Editing (e.g., CRISPR)
- Bioinformatics & Transformative Analytics



Next Generation Sequencing Technology



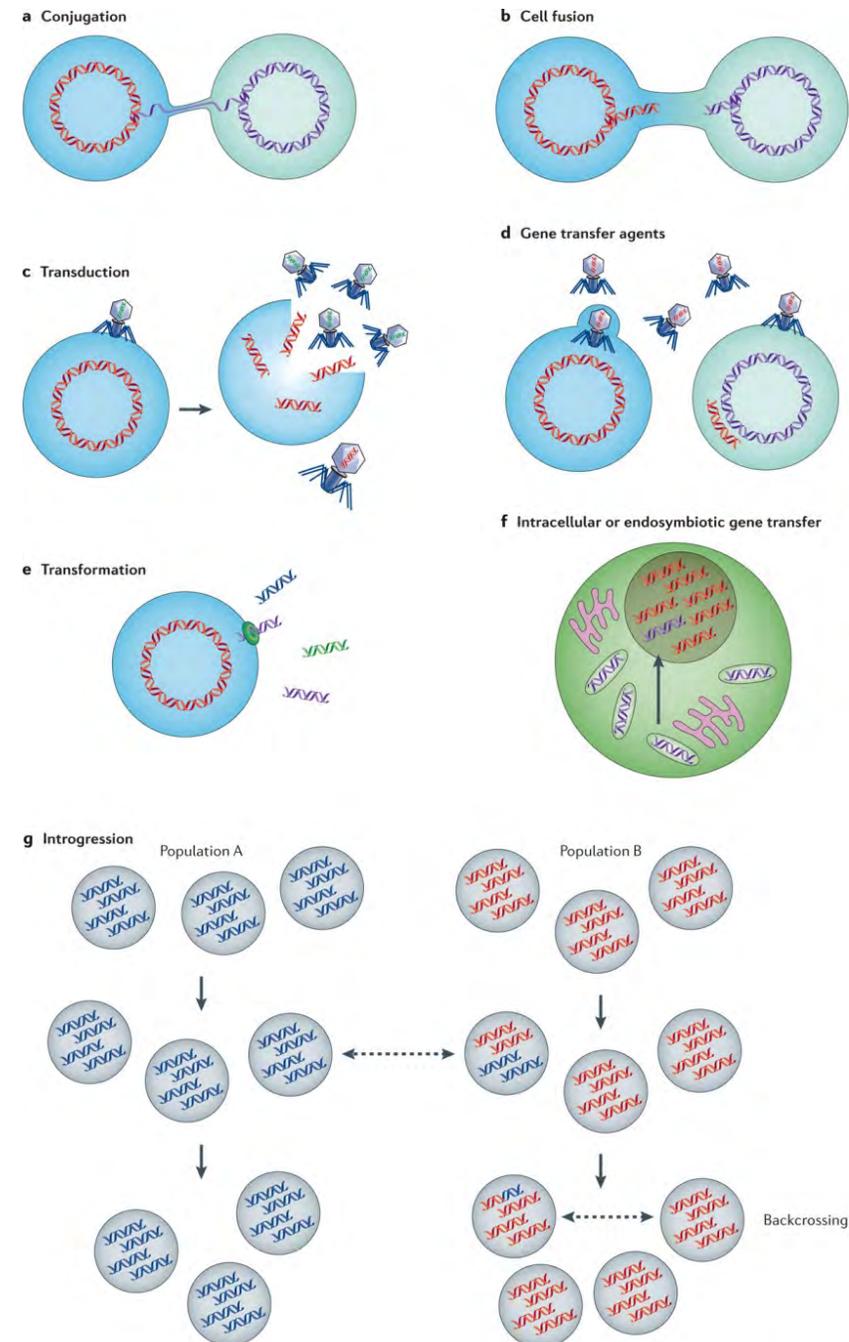
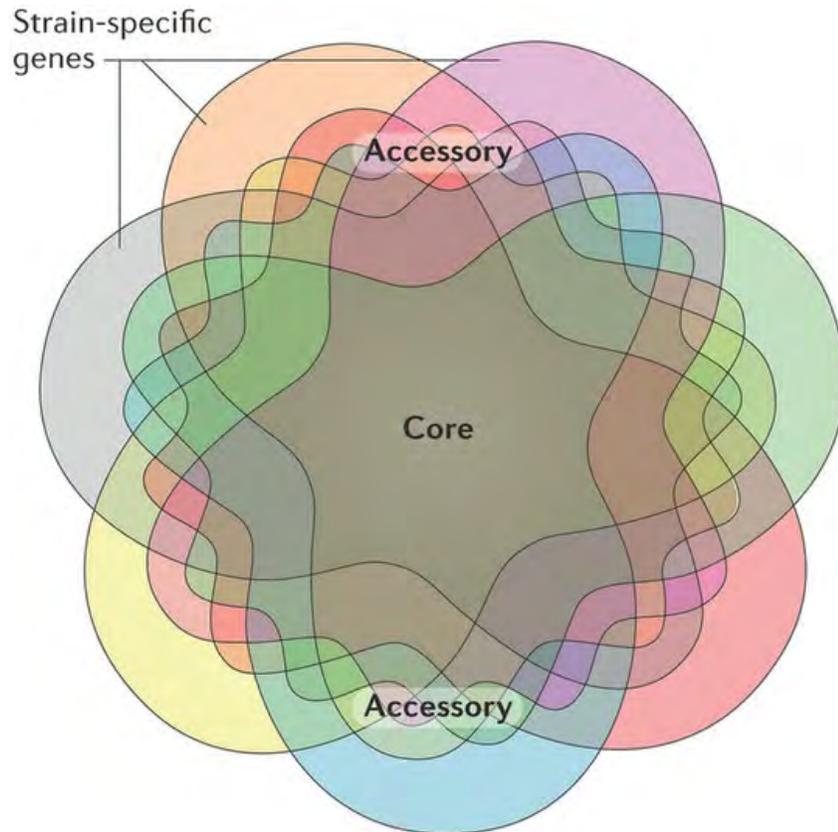
Human Genome Project (1990-2003):

- ❖ >13 Years
- ❖ ~\$3 Billion
- ❖ 3 Billion BP

Our metagenomics AMR study:

- ❖ 5 days
- ❖ \$900
- ❖ >8 Billion BP

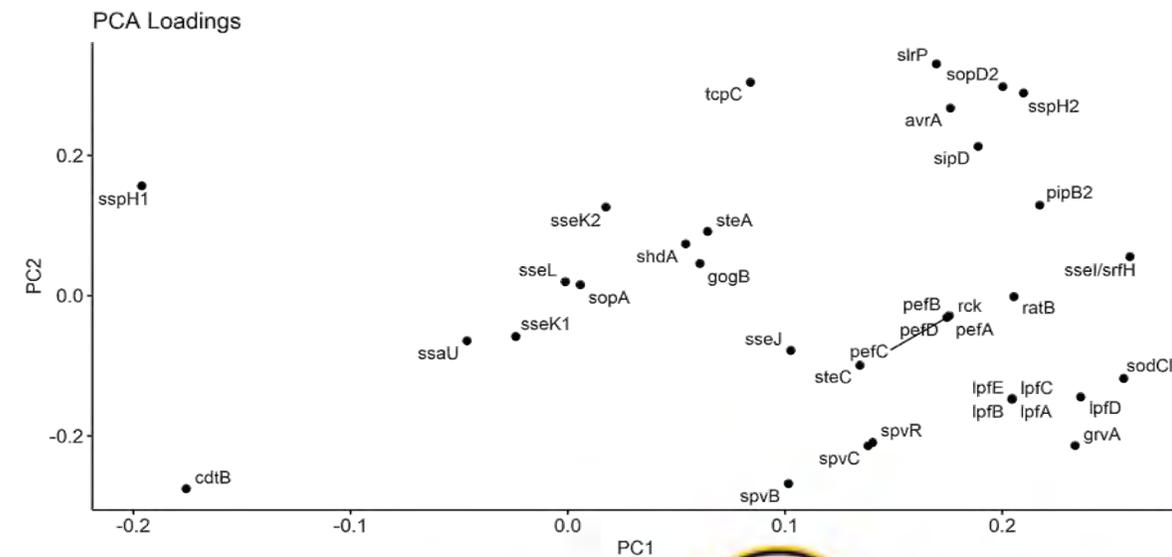
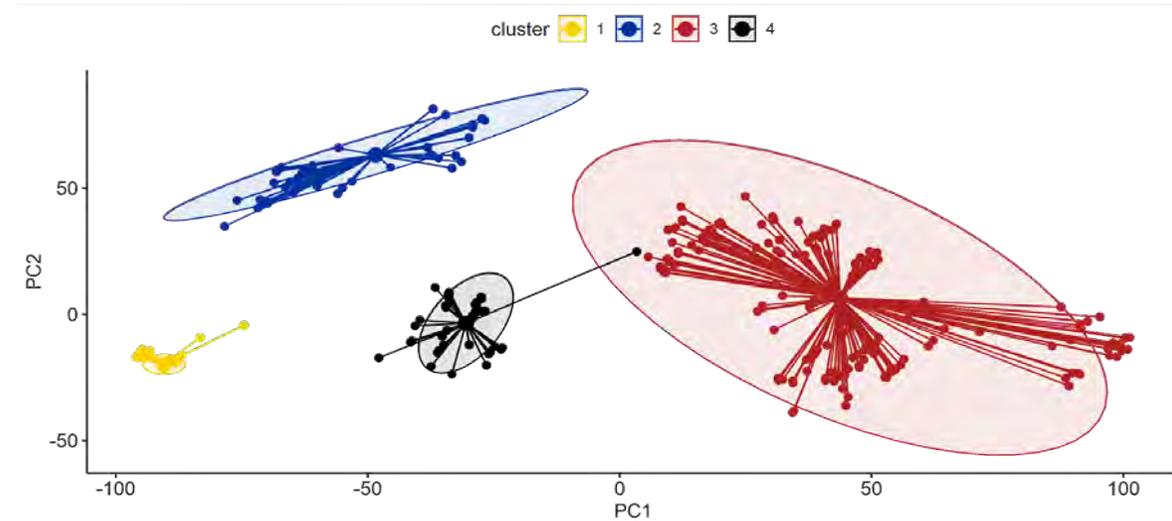
Pan-genomes comprise the core genome, which comprises the genes found in all members of a group of interest, & the accessory genome — genes that are present in only one or a few members of the group.





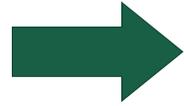
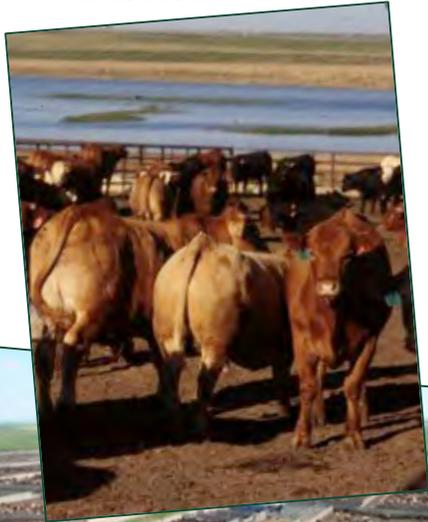
VF Preliminary Analyses

Serovar	Hosp(%)	Inv. Disease(%)	Death(%)
Putative High			
Brandenburg	25.5	11.2	0.6
Muenster	26.5	11.2	2.0
Montevideo	20.2	5.2	0.2
Putative Low			
Dublin	67.0	64.0	3.0
Monophasic	25.0	6.3	0.7
Typhimurium	24.2	5.7	0.6
Infantis	21.3	3.3	0.3
Newport	21.9	1.4	0.3
Muenchen	18.7	1.0	0.3
Putative Low			
Anatum	21.2	2.6	1.0
Cerro	NA	NA	NA
Agona	16.6	2.5	0.8
Mbandaka	23.4	2.4	0.0
Meleagridis	NA	NA	NA
Kentucky	NA	NA	NA
Lubbock	NA	NA </td <td>NA</td>	NA



Ecological Disconnect in AMR Studies?

100s to 1000s of Cattle



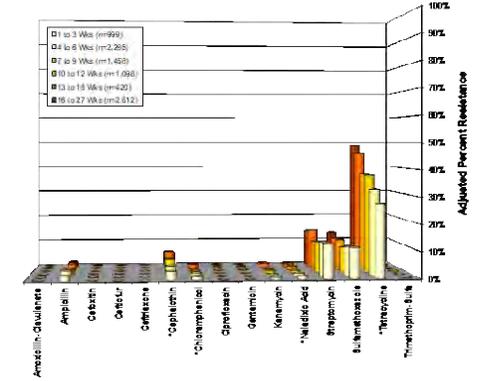
1g from 10-20 animals



1 to 5 Colonies
1 or 2 Species



10-20 AMDs
Conclusions about Risks?

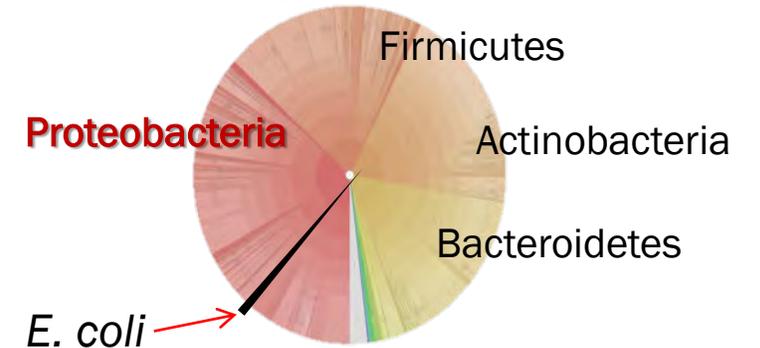


~20-30 kg feces/day



10^9 - 10^{12} bacteria per gram

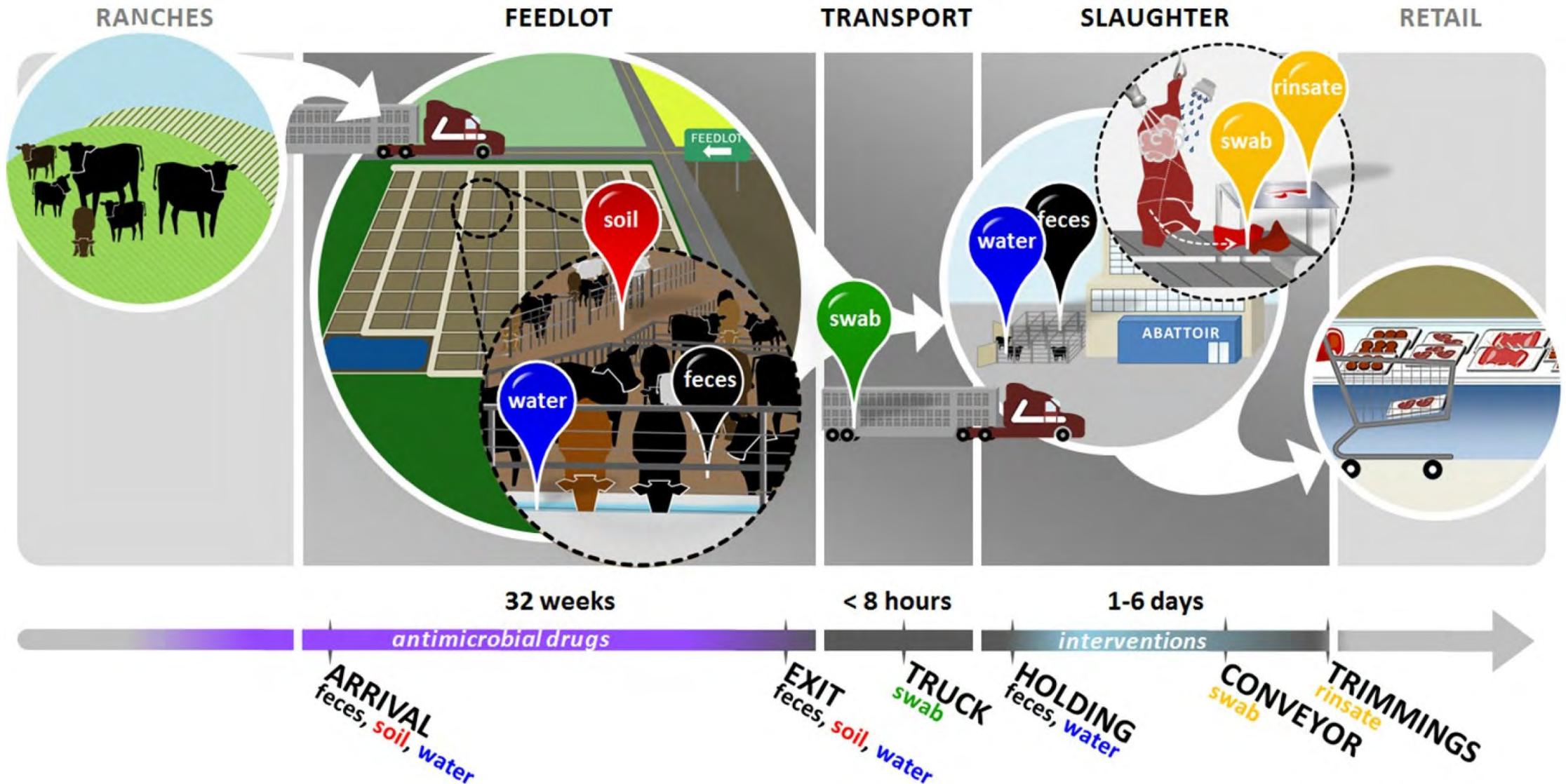
Fecal Microbiome
>1000 bacterial species



What Do We Want to Represent?

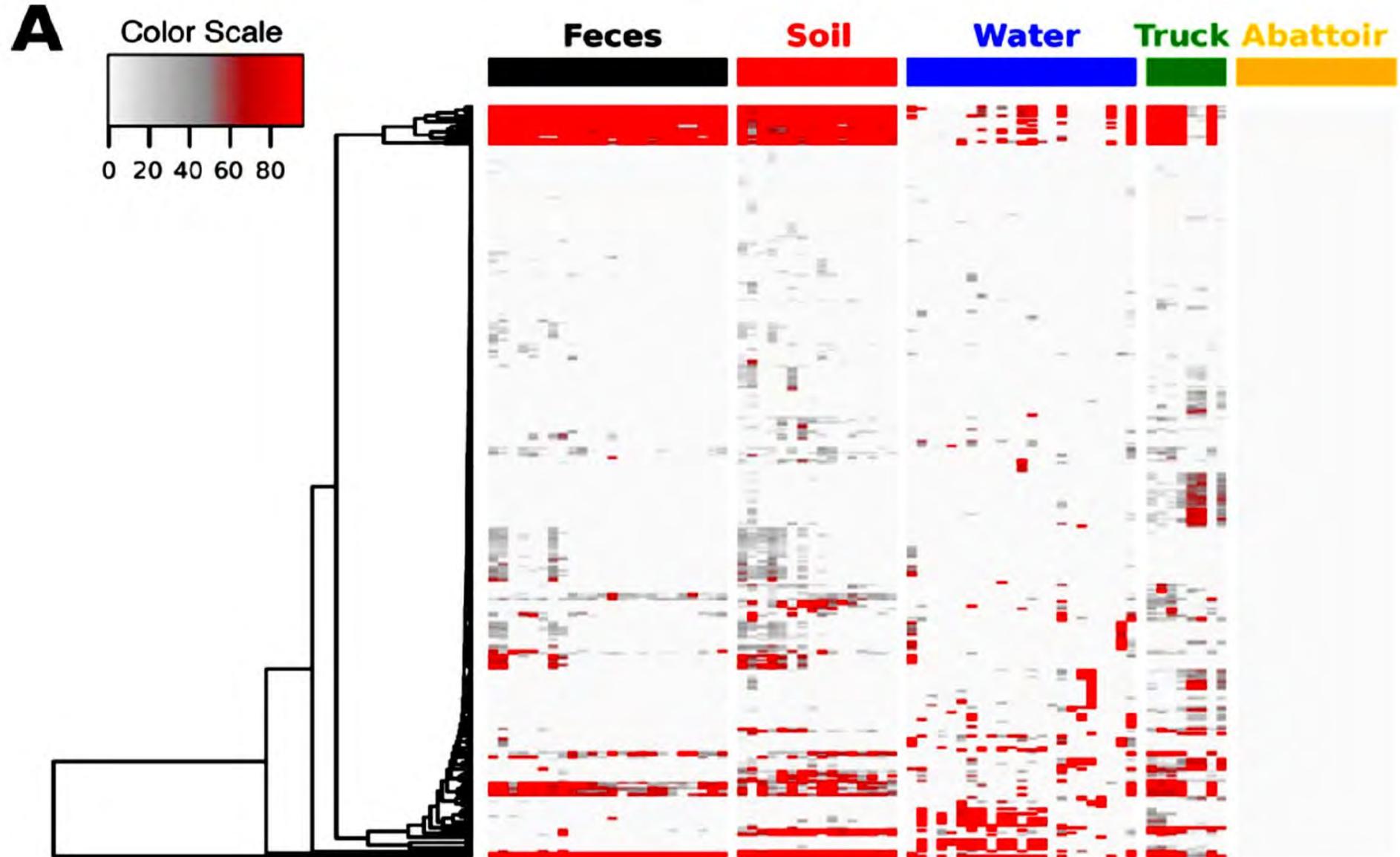
Studies of AMR genes in the beef supply chain & in Liver Abscesses

(Source: Noyes et al., eLife, 2016)



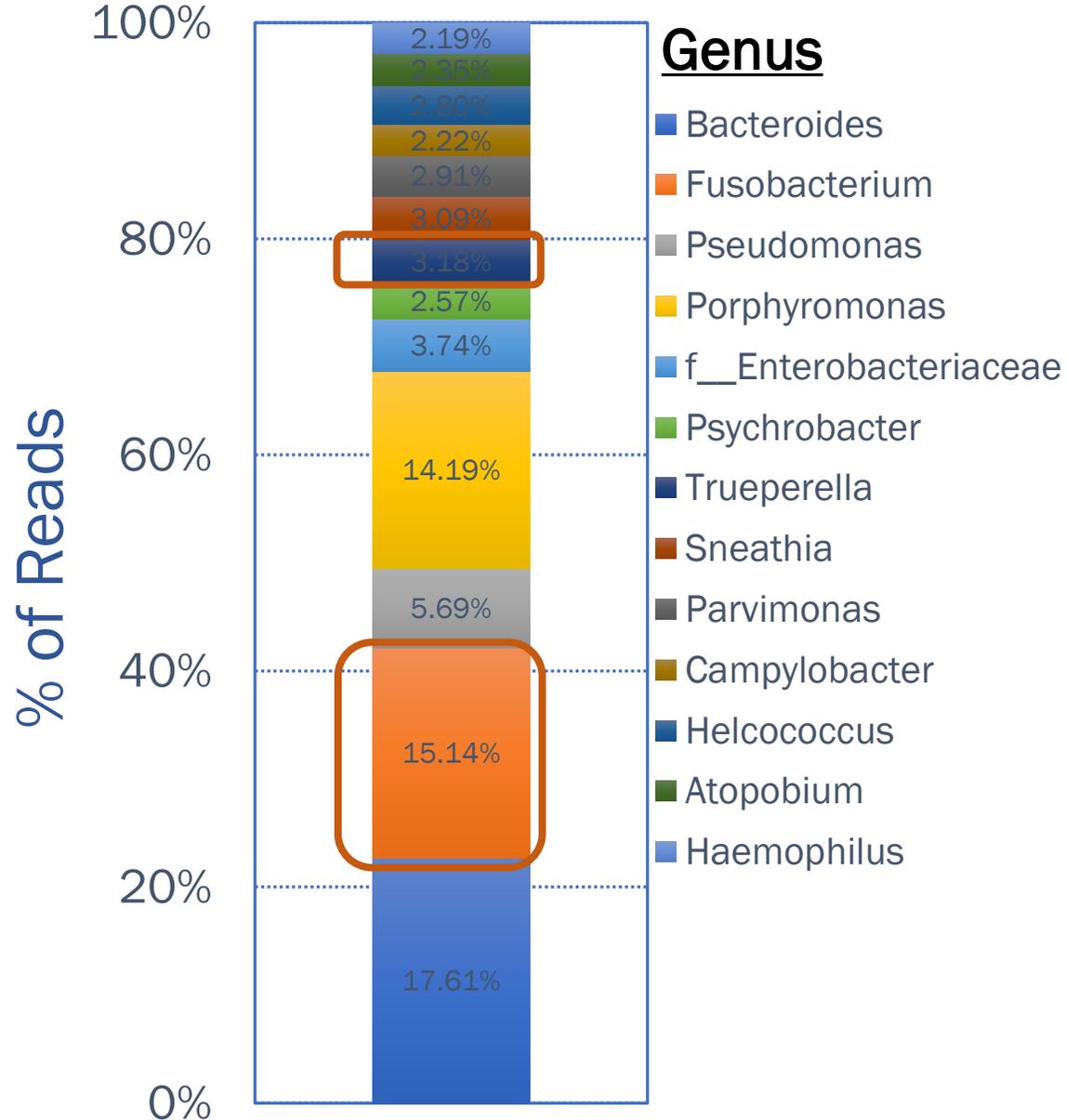
AMR genes ($\approx 7,000$ genes) NOT identified in post-fabrication samples

(Source: Noyes et al., eLife, 2016)



Microbiome Composition of Liver Abscesses

(SOURCE: Weinroth et al., 2017, J. Anim. Sci., 95 : 4520)



- *Fusobacterium* & *Trueperella* found in all liver abscesses.
- Liver abscess bacterial communities were polymicrobial.
- Most organisms identified were gram-negative (Tylosin kills gram-positive organisms).
- While not the primary objective, U.S. feeding location & tylosin supplementation did have an effect on the purulent material community makeup.



Journal of Food Protection, Vol. 84, No. 5, 2021, Pages 827–842

<https://doi.org/10.4315/JFP-20-376>

Published 2021 by the International Association for Food Protection

Not subject to U.S. Copyright

Research Paper

Antimicrobial Resistance in U.S. Retail Ground Beef with and without Label Claims Regarding Antibiotic Use

JOHN W. SCHMIDT,^{1*} AMIT VIKRAM,^{1†} ENRIQUE DOSTER,^{2,3} KEVIN THOMAS,² MARGARET D. WEINROTH,^{2‡}
JENNIFER PARKER,^{3§} AYANNA HANES,³ IFIGENIA GEORNARAS,² PAUL S. MORLEY,⁴ KEITH E. BELK,²
TOMMY L. WHEELER,¹ AND TERRANCE M. ARTHUR¹

¹U.S. Department of Agriculture, Agricultural Research Service, Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Nebraska 68933
(ORCID: <https://orcid.org/0000-0003-0494-2436> [J.W.S.]; <https://orcid.org/0000-0002-6571-9097> [T.L.W.];

<https://orcid.org/0000-0001-9035-0474> [T.M.A.]); ²Department of Animal Sciences and ³Department of Clinical Sciences, Colorado State University,
Fort Collins, Colorado 80523 (ORCID: <https://orcid.org/0000-0001-8351-395X> [M.D.W.]; <https://orcid.org/0000-0002-2384-2628> [I.G.];
<https://orcid.org/0000-0002-3820-8988> [E.D.]); and ⁴Veterinary Education, Research, and Outreach Program, Texas A&M University and
West Texas A&M University, Canyon, Texas 79016, USA (ORCID: <https://orcid.org/0000-0001-8138-2714> [P.S.M.]

MS 20-376: Received 17 September 2020/Accepted 10 December 2020/Published Online 10 December 2020

ABSTRACT

Antibiotics used during food animal production account for approximately 77% of U.S. antimicrobial consumption by mass. Ground beef products labeled as raised without antibiotics (RWA) are perceived to harbor lower levels of antimicrobial-resistant bacteria than conventional (CONV) products with no label claims regarding antimicrobial use. Retail ground beef



Comparative Whole Genome Analysis of *Escherichia coli* O157:H7 Isolates From Feedlot Cattle to Identify Genotypes Associated With the Presence and Absence of *stx* Genes

Mo Jia, Ifigenia Geornaras, Jennifer N. Martin, Keith E. Belk and Hua Yang*

Center for Meat Safety and Quality, Department of Animal Sciences, Colorado State University, Fort Collins, CO, United States

OPEN ACCESS

Edited by:

David W. Ussery,
University of Arkansas for Medical
Sciences, United States

Reviewed by:

Atsushi Iguchi,
University of Miyazaki, Japan

A comparative whole genome analysis was performed on three newly sequenced *Escherichia coli* O157:H7 strains with different *stx* profiles, previously isolated from feedlot cattle [C1-010 (*stx1*–, *stx2c*+), C1-057 (*stx*–), and C1-067 (*stx1*+, *stx2a*+)], as well as five foodborne outbreak strains and six *stx*-negative strains from NCBI. Phylogenomic analysis demonstrated that the *stx2c*-carrying C1-010 and *stx*-negative C1-057 strains were grouped with the six NCBI *stx*-negative *E. coli* O157:H7 strains



Powerful CRISPR-Cas9 Tool

CRISPR

C: Clustered

R: Regularly

I: Interspaced

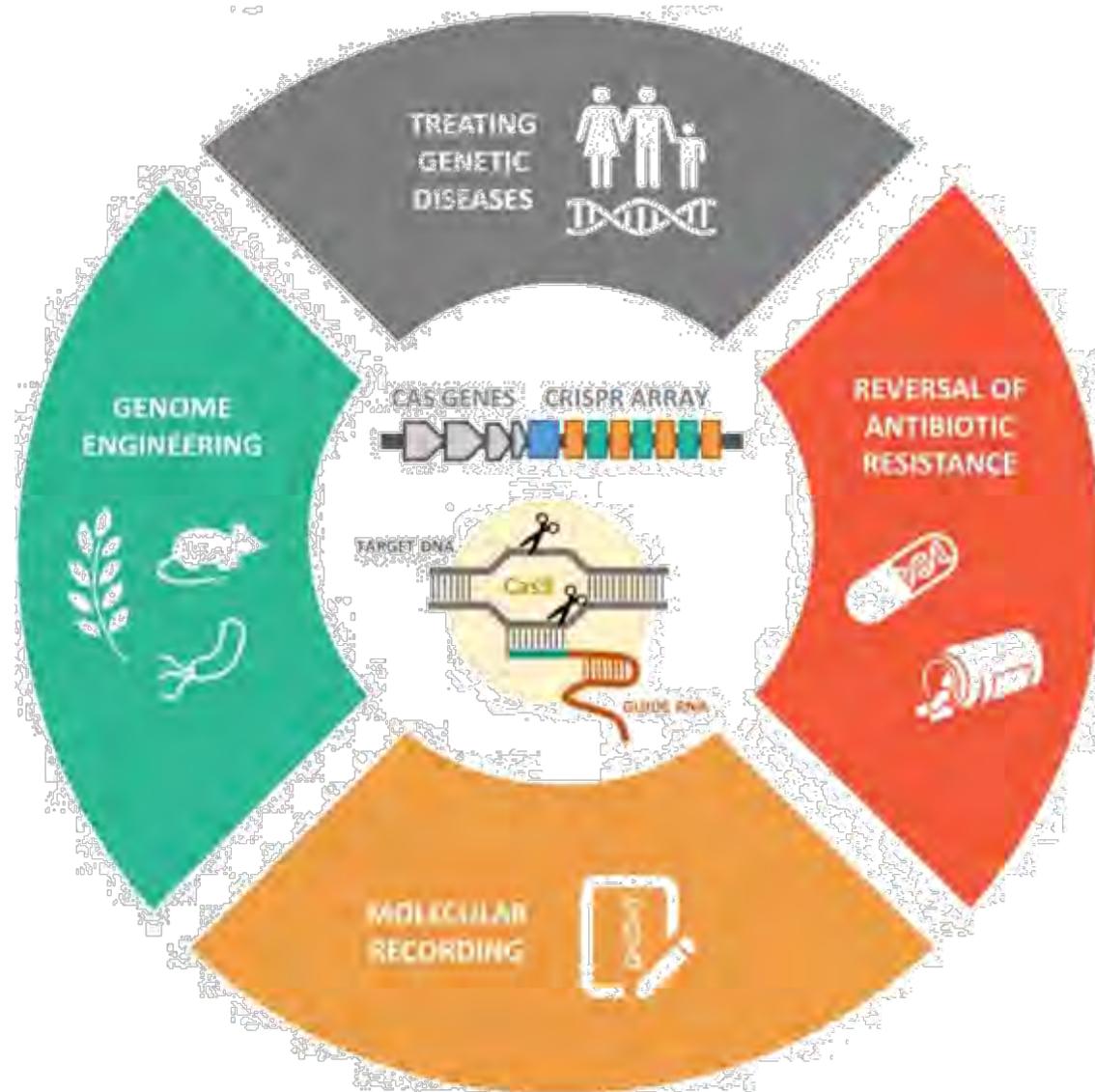
S: Short

P: Palindromic

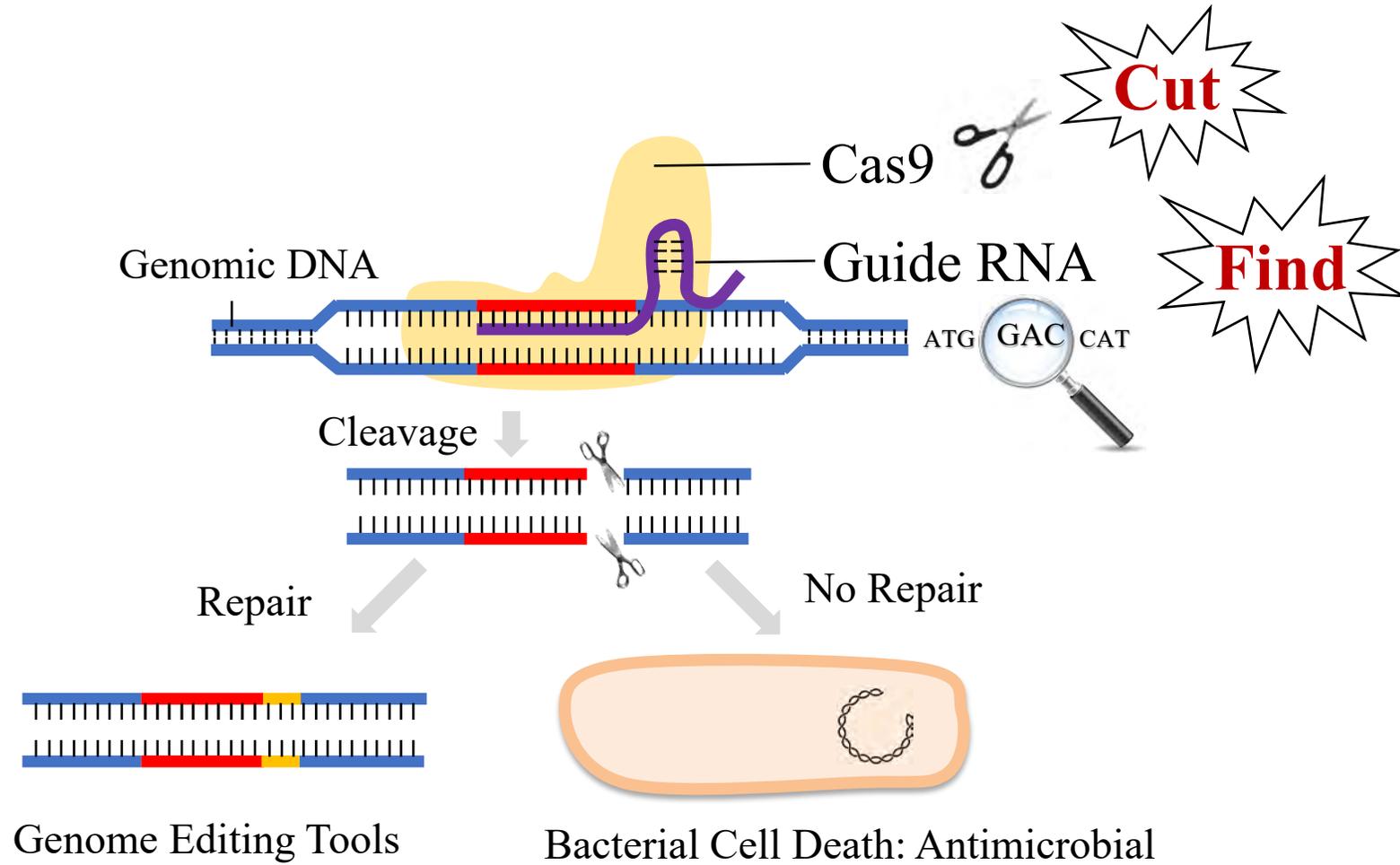
R: Repeats

Cas

CRISPR-Associated Protein



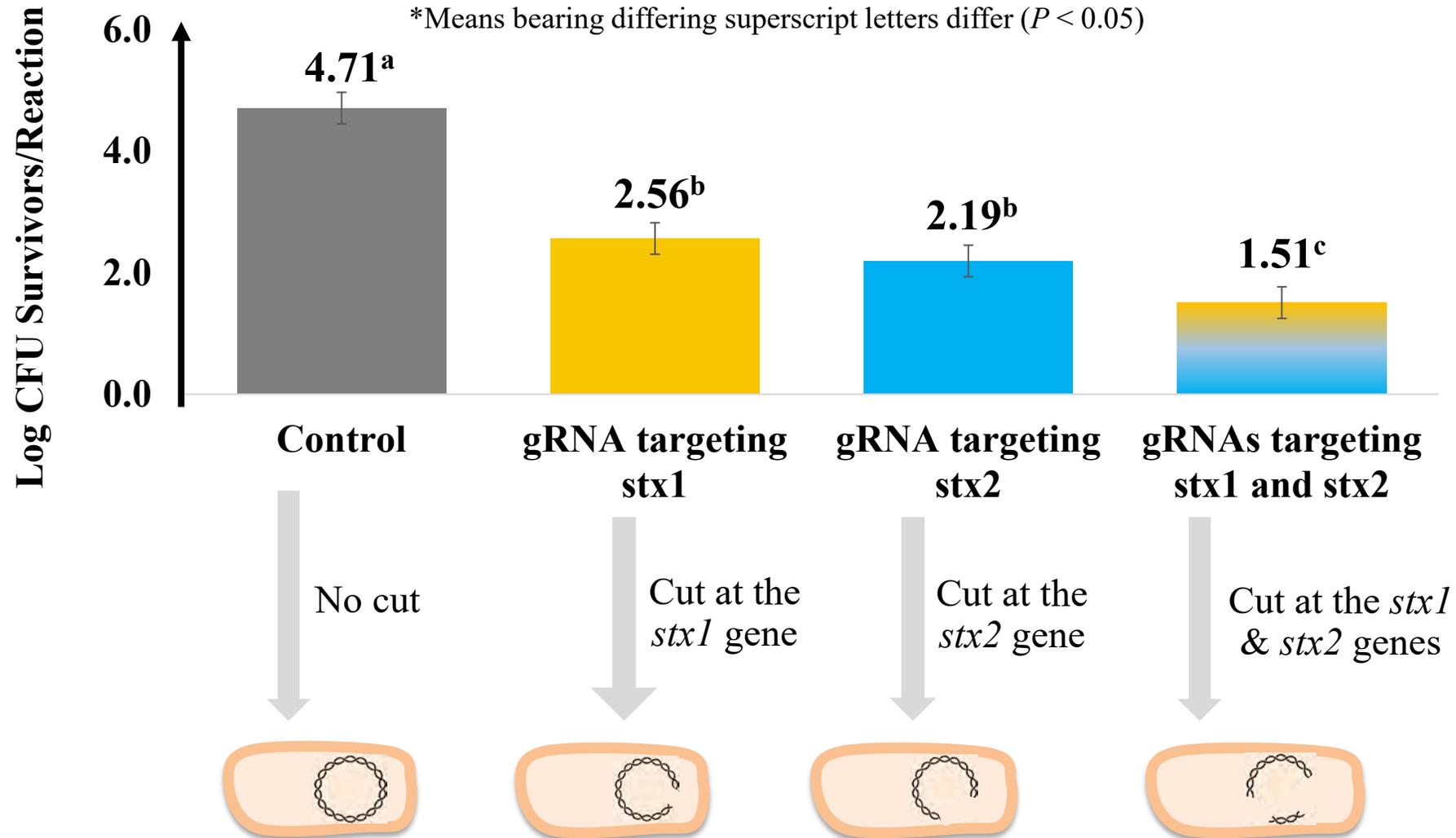
The CRISPR-Cas9 System



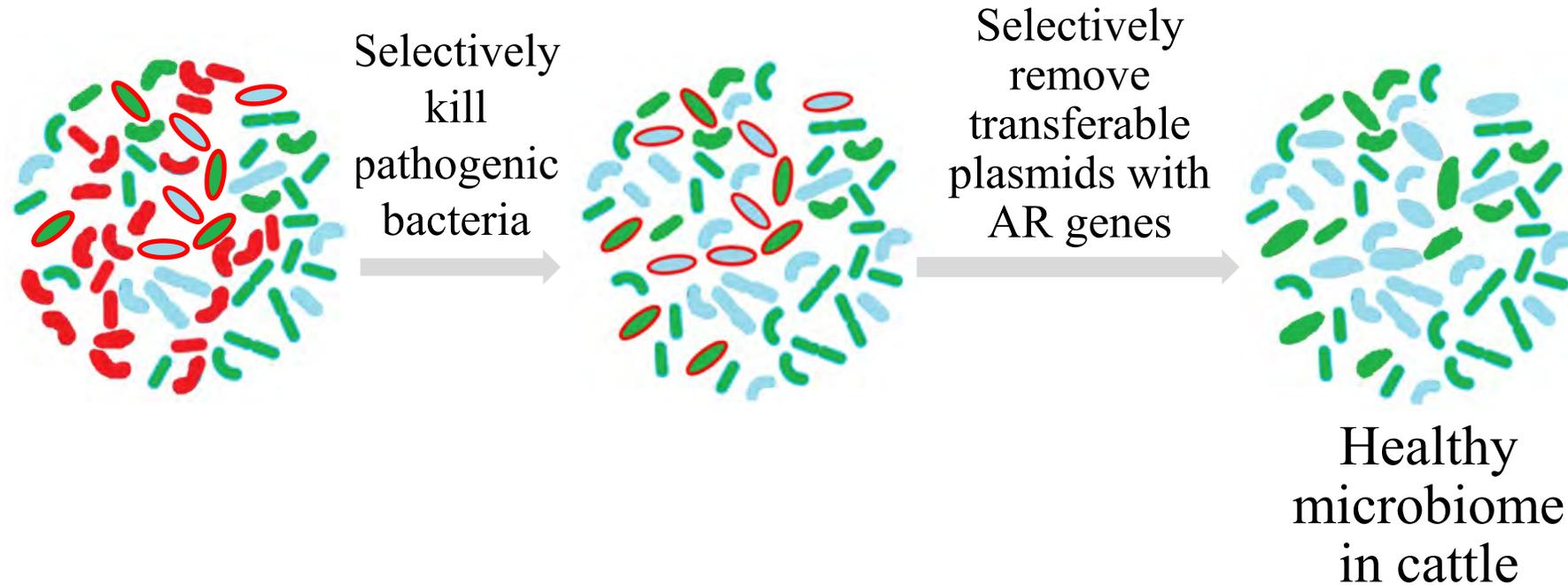
Kill STEC Cells Using the CRISPR-Cas9 System

E. coli O157:H7 Sakai Surviving Cell Populations (\pm SE)

*Means bearing differing superscript letters differ ($P < 0.05$)



Potential Application: Editing Microbiota and Microbiome



 Pathogenic bacteria

 Bacteria containing antimicrobial resistance (AR) genes

 Commensal non-pathogenic bacteria



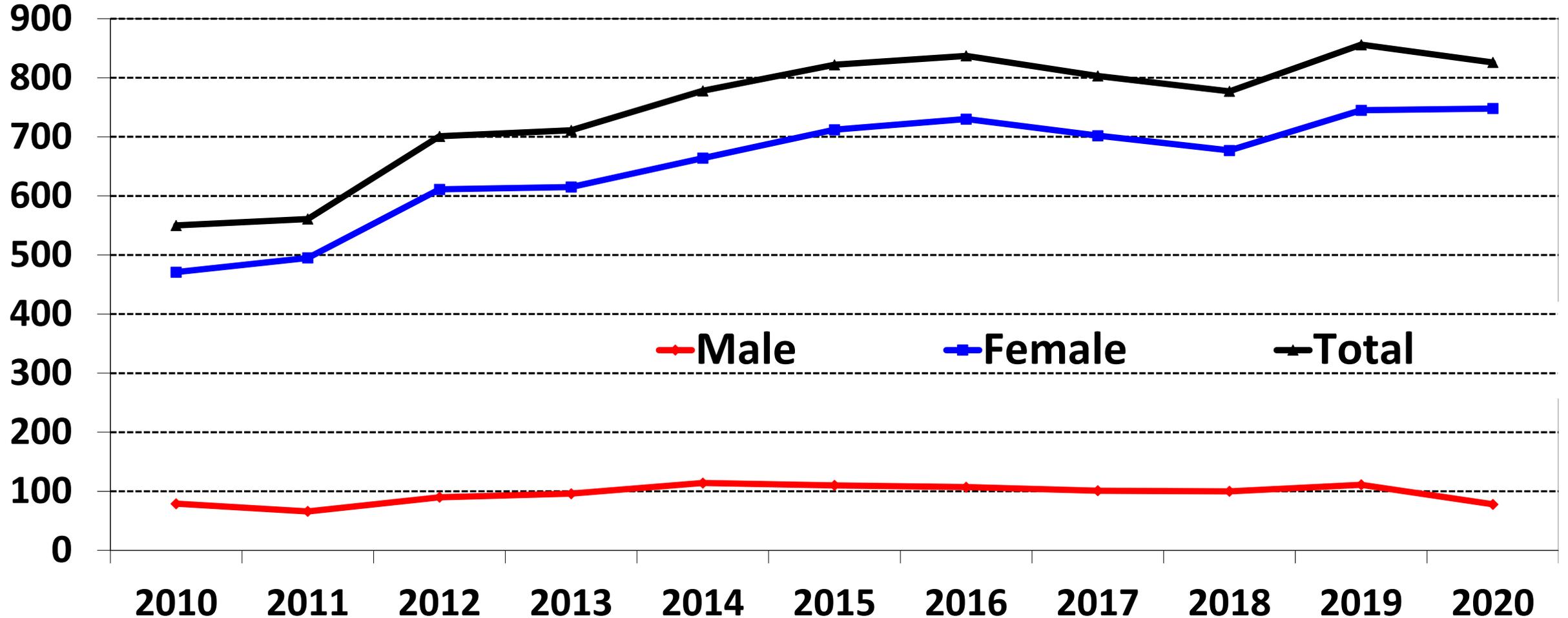
Undergraduate Curriculums

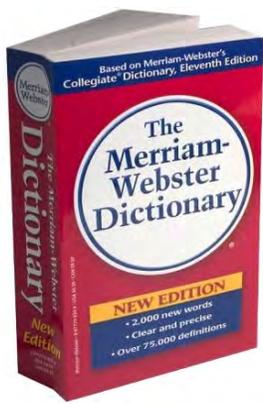
- Desired outcomes/competencies
- Traditional & non-traditional student demographics--challenges
- Create/enhance hands-on learning & decision-making (and failure) opportunities
- Undergraduate research
- Livestock Business Management
- Engagement of industry stakeholders



CSU Department of Animal Sciences Student Enrollment

(from 48 states/15 countries; 47% from Colorado):





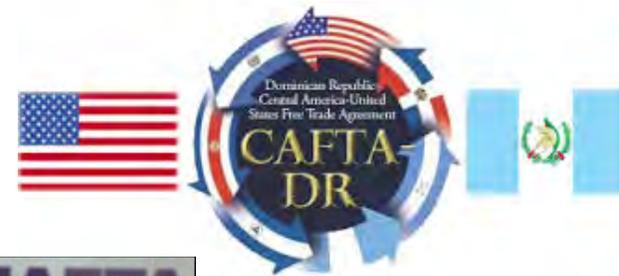
“Globalization”



: the act or process of globalizing;
: the state of being globalized;
especially : the development of an increasingly integrated global economy marked especially by free trade, free flow of capital, & the tapping of cheaper foreign labor markets.

First known use: 1951

SOURCE: <http://www.merriam-webster.com>

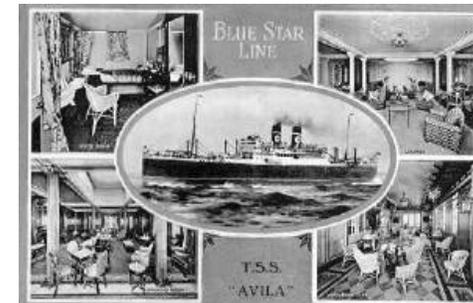
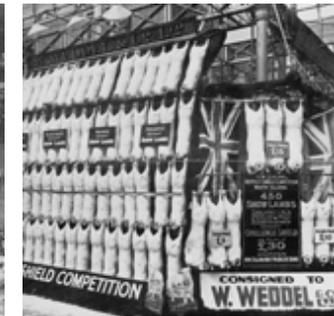


First “Global” Company-Perhaps?

SOURCE: Vestey Foods Group, Ltd, www.vesteyfoods.com, 2014



- From 1890 through the turn of the century, **William & Edmund Vestey** established Union Cold Storage Co. (today Vestey Foods Group) across the UK, Russia, the Baltics, Western Europe, & China; they supplied large quantities of meat, poultry, eggs & fish to a growing UK population.
- Raised livestock on land acquired in Brazil & Australia; purchased additional meat works in New Zealand & Argentina.
- Operated butcher shops throughout the UK, culminating in around 3,000 shops by 1923.
- Built & operated the Blue Star fleet until 1998.



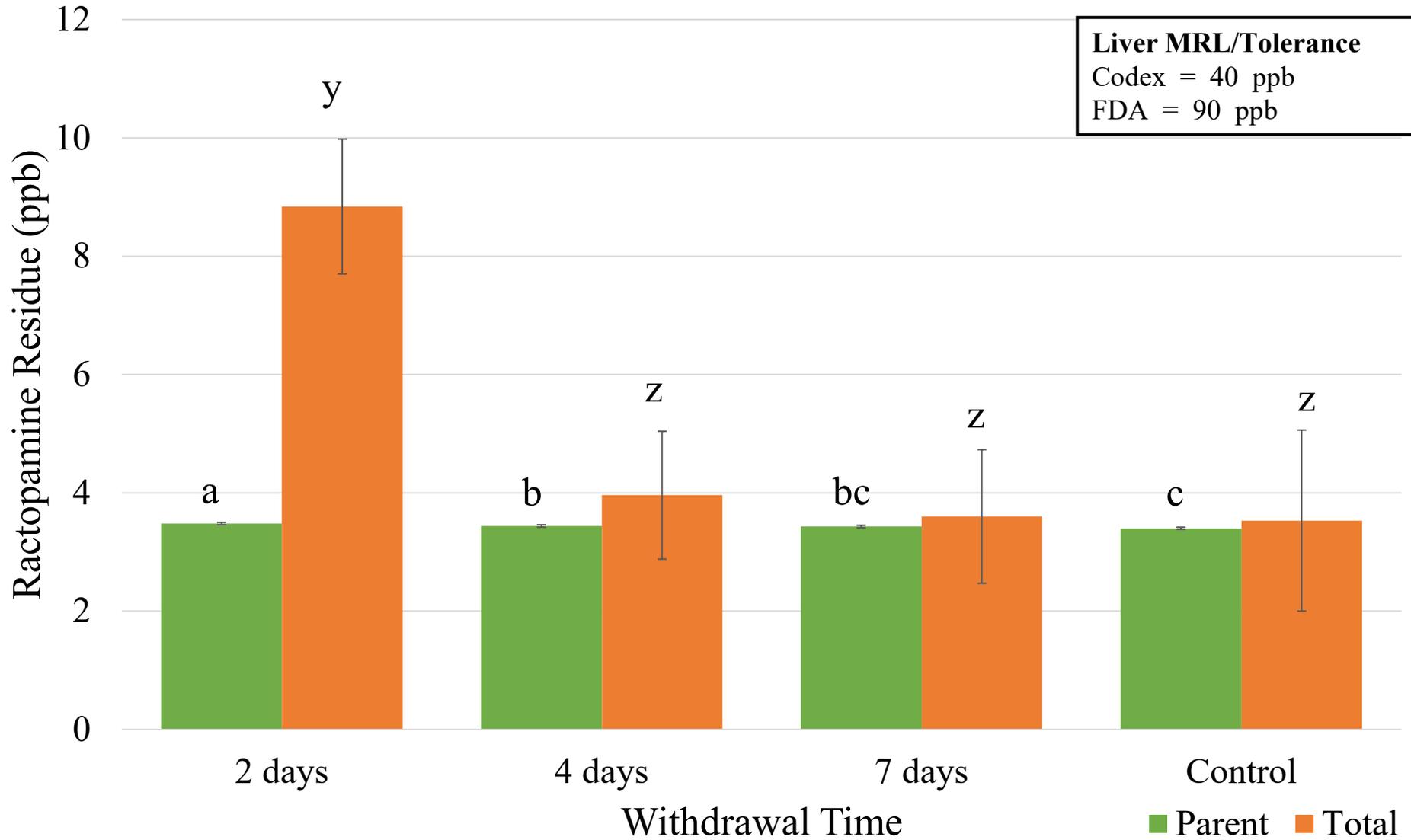
Global Meat & Poultry Companies



In no particular order & not limited to:

- JBS S.A.
- Tyson Foods
- WH Group (formerly Shuanghui Intl.)
- Cargill Meat Solutions
- Marfrig Global Foods
- Brasil Foods (BRF)
- Danish Crown
- Itoham Foods
- Gruppo Cremonini
- Teys Australia (Joint venture w/ Cargill)
- Hormel Foods
- SuKarne
- Nippon Meat Packers
- ANZCO Foods
- Minerva Foods
- Sigma Alimentos
- OSI Group
- Maple Leaf Foods

Liver



abc Columns without a common superscript differ ($P < 0.05$).

yz Columns without a common superscript differ ($P < 0.05$).

Error bars constructed using 95% confidence intervals.

■ Parent ■ Total

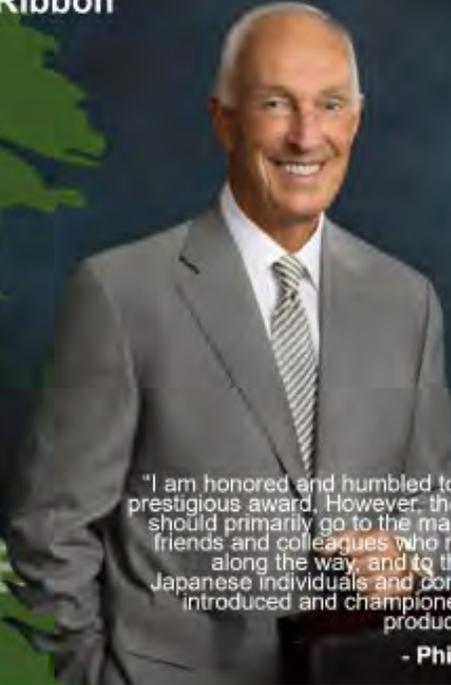
LOD (ppb) 0.002

LOQ (ppb) 0.006

CSU Professor Phillip M. Seng Awarded Japan's Highest Civilian Honor, Order of the Rising Sun, Gold Rays with Neck Ribbon



ANIMAL SCIENCE
COLORADO STATE UNIVERSITY



"I am honored and humbled to receive this prestigious award. However, the recognition should primarily go to the many Japanese friends and colleagues who mentored me along the way, and to the numerous Japanese individuals and companies who introduced and championed U.S. meat products in Japan."

- Phillip M. Seng

2021-SPRING-Term

- Home
- Announcements
- Syllabus
- Modules
- Assignments
- Grades
- Discussions
- Quizzes
- People
- Rubrics
- New Analytics

View All Pages

Front Page

Published

Edit

Home - Edit or use your own Page

Welcome to ANEQ 480A2: Exploring Meat Export Opportunities



Students, to get started, please go to [Modules](#) and read the [Start Here](#) page.

New Course Offering – Spring 2021!

Exploring Meat Export Opportunities

ANEQ 480 Group Study (section 001)

11:00-11:50 pm Mondays / Wednesdays

March 22 – May 14, 2021 (second 8 weeks)

Learn from industry leaders and experts about how the U.S. meat industry put meat on the World's Table. Topics such as carcass utilization, trade support, buyer education and loyalty, market presence, product image and market access will be discussed. Weekly discussions will occur from industry experts located in Japan, Mexico, South Korea, China, Hong Kong, Taiwan, Singapore, Eastern Europe, and the Caribbean. The course will include actual case studies and discussions about real-world events. **This is a one-of-a-kind course not offered at any other university!**





畜産日報

DAILY MEAT & LIVESTOCK

●発行所 株式会社 食品産業新聞社

〒100-0013 東京都千代田区東上野2-1-1 TEL: 03(474)7111 FAX: 03(474)7112
〒320-0044 栃木県宇都宮市東大塚1-1-1 TEL: 028(571)2111 FAX: 028(571)2112

●購読料(前納) 6カ月/本体 37,700円+税 1年/本体 73,200円+税

焼肉商材(輸入・国産)
専門の卸と加工



フカセ食品株式会社
〒108-0023 東京都港区南青山2-4-2 TEL: 03(5452)4046 FAX: 03(5452)4995

2021年(令和3年) 3月22日 月曜日 第14980号

CONTENTS

禁無断転載

- 宣言解除後も外食産業はガイドラインを突破、利用者は短時間で深酒しない・・・2
- 養鶏農家自主点検は36都道府県で100%達成、5月まで緊張感を一野上農水大臣 2
- 1月ハムソー生産0.4%減の3.9万t、ウィンナー、ベーコン増加、ロース減少・・・2
- 食肉処理業向けHACCP、A基準案を議論、厚労省の検討会を経て公表へ・・・3
- 50人未満であっても、衛生管理のステップアップでA基準を目指すことを想定・・・3
- 「アレルギー クイックPluswab」、ふき取りから検査まで1つで実現—プリマ 3
- 役員・執行役員人事、組織変更を発表—伊藤ハム米久ホールディングス・・・4
- 2月の鶏肉輸入は2%増の4.5万t、3月は6%減・4.4万tと予測—輸出入協会 4
- 19年輸入解禁のウェルシュ・ラム、チルドに続きフローズンでの輸入開始・・・5
- 汎用性の高いウデで多様なメニュー紹介、価格優位性や安定供給のメリット訴求 5
- 静岡の丸神食品が再生手続き開始決定、スポンサー企業を招へい・・・5
- 4~6月期の配当価格t当たり5,500円値上げ、前期と合わせ9,400円高一全農 6
- センクMEF前会長がコロラド州大で講義、マーケットインの発想で貿易実務・・・6
- 「仮面ライダーセイバー ウィンナー第2弾」発売—丸大食品・・・7
- 米久、ソーセージおじさんをデザインしたお弁当ソーセージを静岡県内で発売・・・7
- 1位に高麗産鶏サラダチキン125gが上昇—2月POSその他加工肉・・・7
- 【関東・関西輸入牛肉調仲間相場】玉蹄で全体の相場が上昇・・・7
- △ 牛枝肉相場・豚枝肉相場・流通センター豚部分肉相場(19日)・・・8
- 資料—POSデータ売れ筋商品ランキング⑩(21年2月・その他加工肉)・・・9
- 資料: 穀物等の国際価格の変動(ドル/ブッシェル)—農水省・・・10
- 資料: 穀物の生産量、消費量、期末在庫率の推移—農水省・・・11



食品産業のトレンドを読む食品の総合紙

いま、食品業界はインターナショナル、ボーダレスの時代。異業種、他の業界がどのような動きにあるのか、また、食品産業のトレンドは何か。食肉業界にとっても、食品産業全体の動きを先取りし、新たな動きに対応していくことが求められています。そのニーズに応えるのが「食品産業新聞」です。

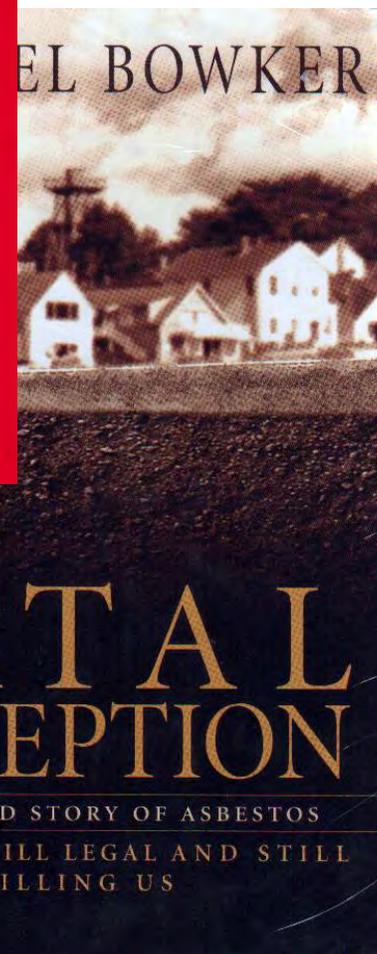
発行:週2回(月・木曜日) プランケット判、購読料:6カ月23,000円+税

CSU Export Class Makes The News!

MAFF officials already responded if they could join the course.



Consumer Lack of Trust—Precedents



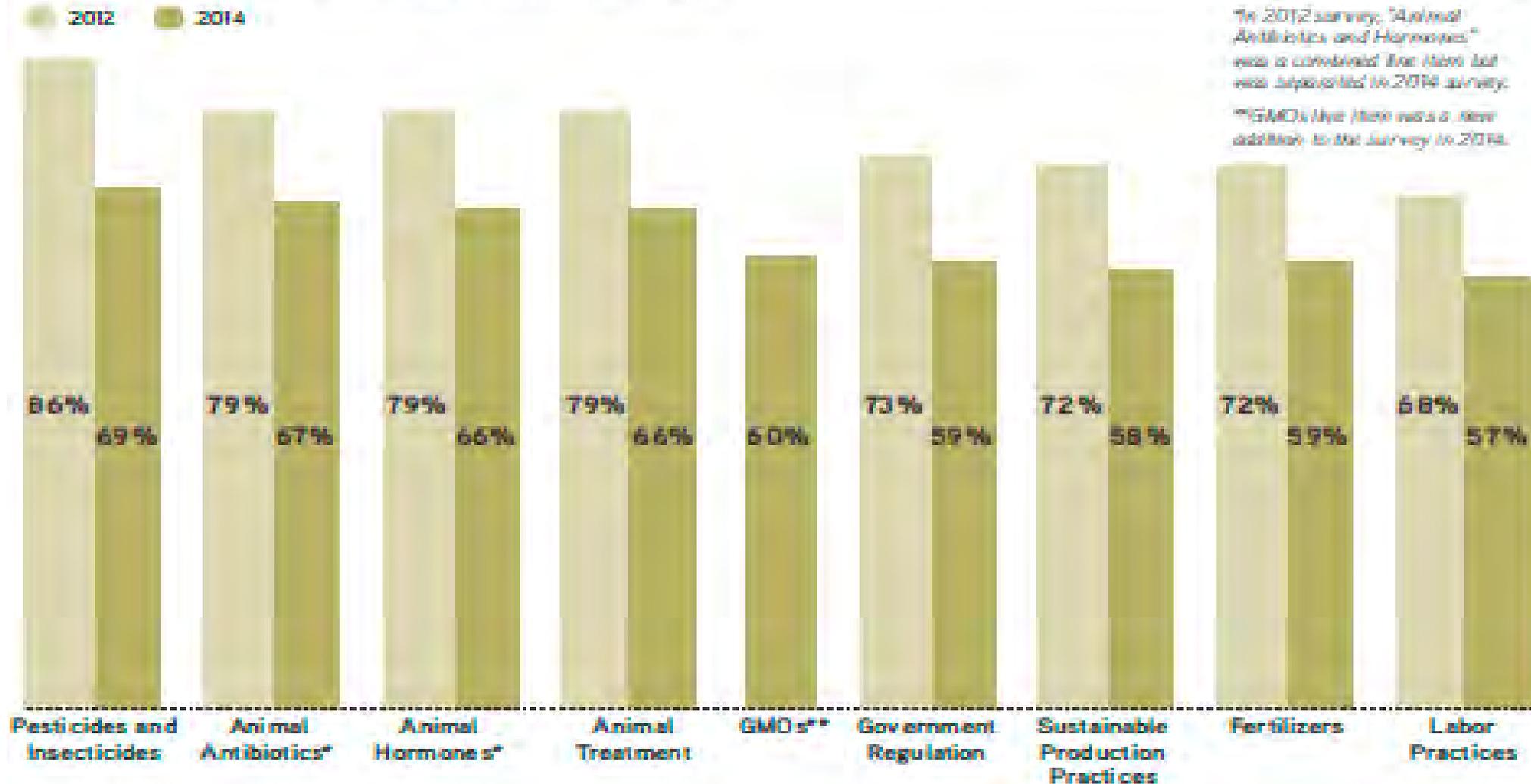
Mar 26, 2008 3:37 AM CDT



Americans "Trust" in Food Production

SOURCE: Sullivan Higdon & Sink, *FoodThink: Emerging Faith in Food Production*, March 2014

Concern toward food production topics



Growth in Farmers Markets

SOURCE: USDA-AMS

USDA Agricultural Marketing Service
U.S. DEPARTMENT OF AGRICULTURE

Almost all farmers markets stayed the same size or added new vendors in 2019.

51.8%

of markets had the same number of producers/vendors.



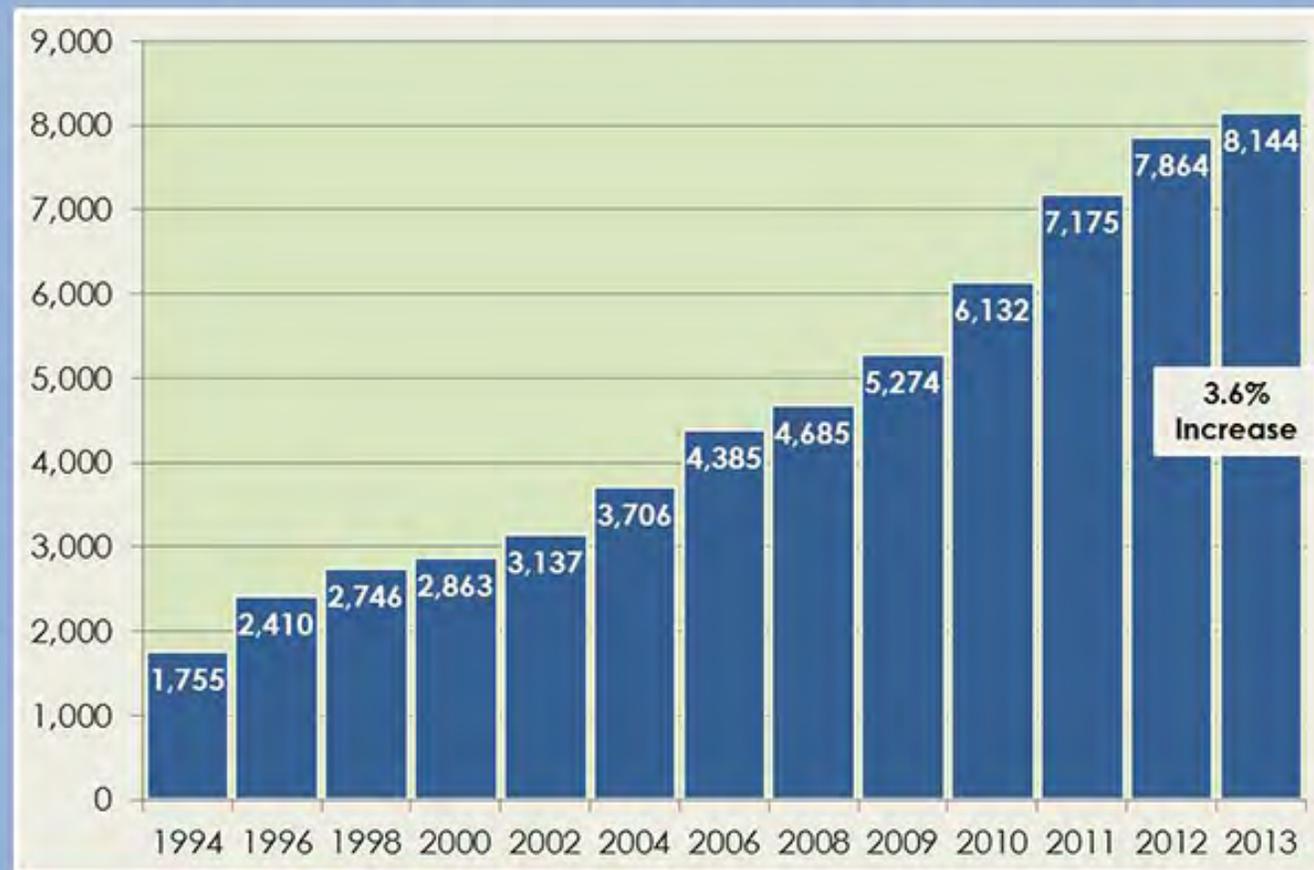
36.8%

of markets increased the number of producers/vendors.



Source: 2019 National Farmers Market Managers Survey

National Count of Farmers Market Directory Listings



Source: USDA-AMS-Marketing Services Division

Farmers Market information is voluntary and self-reported to USDA-AMS-Marketing Services Division



THANK YOU!