Wheat Fiber for Rural Wealth and Health Roundtable

Transforming Global Food Supply: Wheat Fiber as a Fuel for Rural Wealth and Health

Dr. Rod Wallace
Foundation for Innovation in Healthy Food

November 7, 2024

Our New Paradigm

Rural Wealth and Health for All

- Agriculture and Public Health Working Together
- Better Commodities
- Saving Government Money WITHOUT Costing Households
- Triple win:
  healthcare savings, farmer profit, and healthier communities.

Agenda

COALITION FOR GRAIN FIBER

- Saving Lives at Global Scale
- Low-cost, World-Class Science
- Business Opportunity for Farmers
- How You Can Help

Who we are…

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

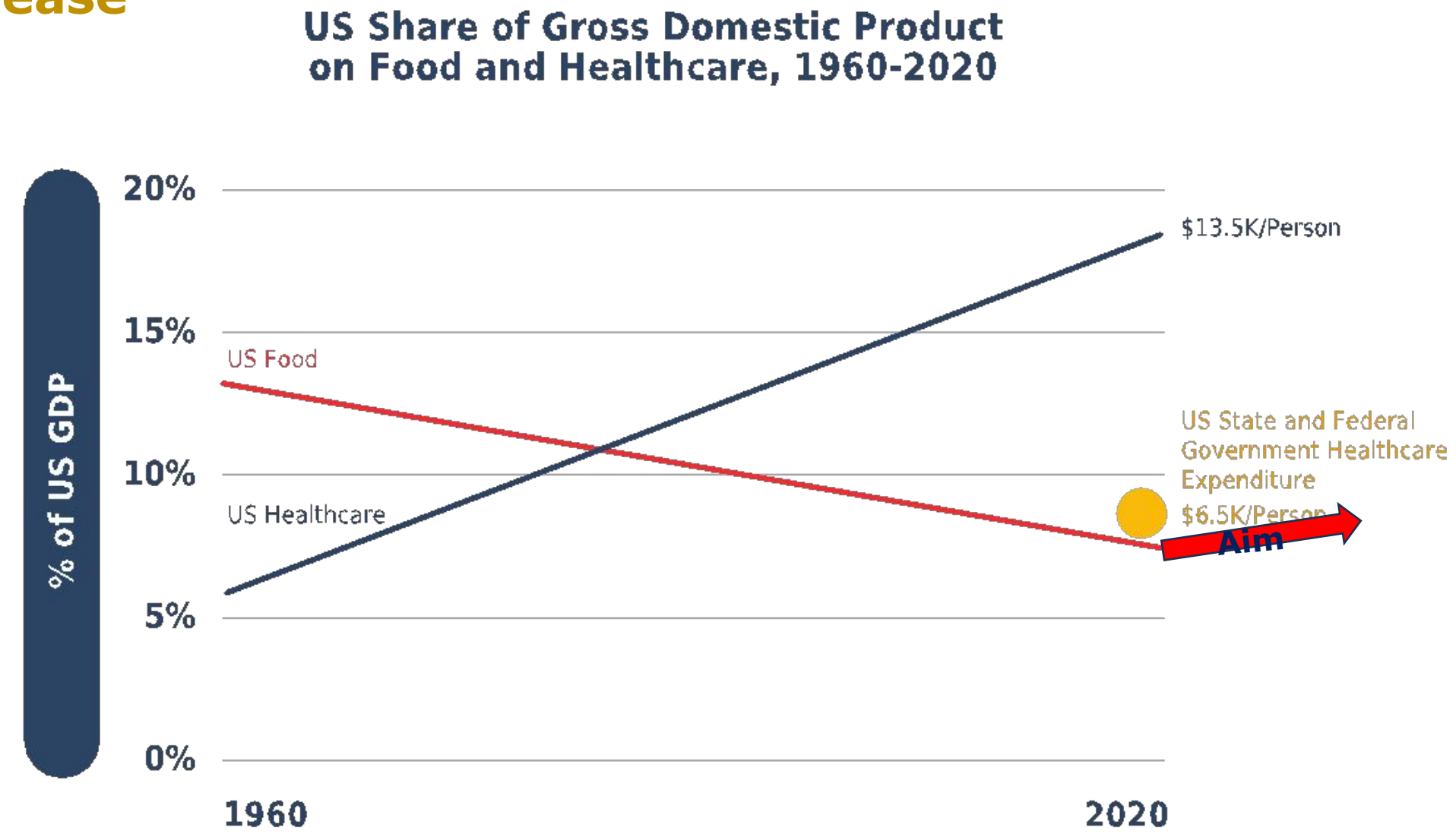
COALITION FOR GRAIN FIBER

Nonprofit 501(c)3 saving lives and reducing healthcare costs at global scale by enhancing nutrition in commodity food supply.

We Aim

Shift Trajectory of National Responses to Chronic Disease

FOUNDATION FOR INNOVATION IN HEALTHY FOOD



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4679631/

The Power of Our
Favorite Foods

- 20% of global calories and protein
- White flour fortification cuts birth defects 25-50%
- Largest source of fiber in American diets (33%)

Immense Cost of Chronic Disease
Becomes an Opportunity

US Cost of Cardiovascular Disease (CVD) + Diabetes

National
$700 Billion
Each year

50 times larger than annual US Wheat Crop ($10-20B)

Family of 5
Over $10,000
Each year

+ Others

CUT by Dietary Fiber

Copying Food Industry's Proven Success Model

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Little by Little, Better and Better

Cost

Fortification*

- Fluoridated water: cut cavities
- Fortified white flour: reduced birth defects
- Vitamin D dairy: nearly eradicated rickets

Food safety*

* 20th Century Greatest Public Health Strategies

Our Focus

Top 3 Foods' Diet Share

Global 51%
7 Foods 70%

US 33%
13 Foods 84%

Financial incentives building on existing policy and strategies

A Paradigm Shift Learned from History

Modest Improvement in Foods Eaten By Everyone Several Times a Day

Most Impactful Health Strategies

Fortification*

- Fortified white flour birth defects ↓
- Vitamin D dairy rickets ↓
- Others

Food safety*

Our Attractive Choices

Top 3 Foods' Diet Share

Global 51%
7 Foods 70%

US 33%
13 Foods 84%

Financial incentives building on existing policy and strategies

Without relying on consumers to change behavior

* 20th Century Greatest Public Health Strategies

The Star of Our Show

Increased Arabinoxylan Fiber Wheat (Lincoln, NE)

COALITION FOR GRAIN FIBER

A 20-Year Path from an EU Study*

The Health Grains Movement for Better Wheat

COALITION FOR GRAIN FIBER

* Based on conversation with Peter Shewry, October 30, 2024

Commercial viability *baked in*, plus:

Nutrition

- Increased Fiber
- Tocopherols
- Tocotrienols
- Vitamin B
- Others

Health Options

- Variation
- Scientific health support
- Population health
- Control

Making a Difference

Coalition for Grain Fiber: Natural, Innovative, Healthy, Prof

COALITION FOR GRAIN FIBER

Natural, public-health focused **science,** at scale.

High-quality, natural (non-GMO), increased-fiber commercial wheat:

85%+ success

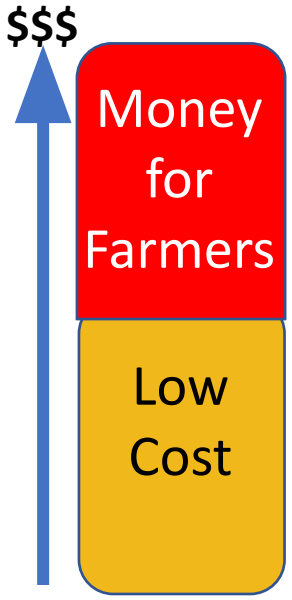
*Nutrition Models**

Cardiovascular disease 1-3%

Diabetes Type II: 3-4.5%

*Reduction will depend on populations' actual diets

Align incentives for public health



Policy and Business Options

Current commodity supply chain; Current price on lowest-cost staples

* Hard wheat commodity supply; soft wheat opportunities may also be promising

Seasoned Commercial and Science Exper

Coalition for Grain Fiber

COALITION FOR GRAIN FIBER

Seasoned Commercial Team

Rod Wallace, PhD

Business Strategist and

Fernando Arias, MBA

	# Members
Wheat Farmers	3
Supply Chain	3
Sales / Marketing / PR	7
Extension, Engagement	4
Other Advisors	6

Industry experience from across the food supply chain and beyond.

World-Class Science Advisors

Stephen Baenziger, PhD
Emeritus Professor and Wheat Growers Presidential Chair, University of Nebraska

Barbara Schneeman, PhD
Emeritus Professor, University of California, Davis Former Director of the Office of Nutrition, Labeling, and Dietary Supplements, US FDA

William Wilson, PhD
University Distinguished Professor, North Dakota State University

Ed Souza, PhD
Research Consultant, Former Global Director of Wheat Breeding, Bayer, and Director of a USDA Wheat Quality Laboratory

Andrew Benson, PhD
Food for Health Presidential Chair and Director, Nebraska Food for Health Center WW Marshall Distinguished Professor of Biotechnology, University of Nebraska, Lincoln

Peter Shewry, PhD
Former Assistant Director, Rothamsted Research

Jennifer Yates, PhD
Wheat Breeding Lead, Bayer Crop Science

Margaret R. Bath, PhD
Chair, CIMMYT Board of Trustees and Former Chief Technology Officer, Kellogg Company

Jan Delcour, PhD
Professor Emeritus, KU Leuven, and Chairman of the Leuven Food Science and Nutrition Research Centre (LFoRCe)

Bin Zhao, PhD
Senior Principal Scientist, Grupo Bimbo

World Class Science Team

Coalition for Grain Fiber

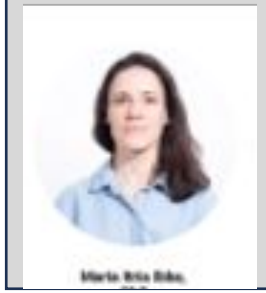
COALITION FOR GRAIN FIBER

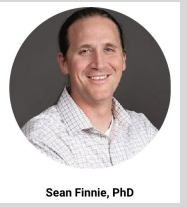
Leaders
Plant Breeding

Team
 # Members, Advisors

38

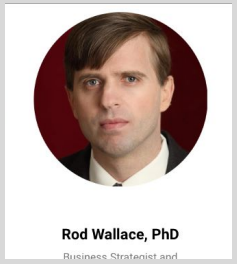
End-Use Quality





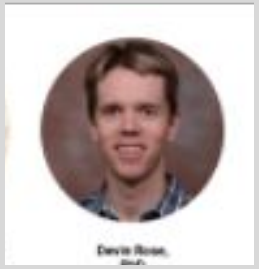
14

Socioeconomics



6

Nutrition / Health



6

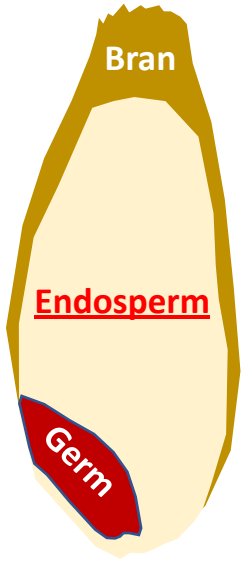
Agenda

COALITION FOR GRAIN FIBER

- Saving Lives at Global Scale
  - Good science, financial incentives, and a world-class team
- **Low-cost, World-Class Science**
- Business Opportunity for Farmers
- How You Can Help

A Doable
Fiber Increase in White Flour and Whole Grain

COALITION FOR GRAIN FIBER



Target fiber in endosperm cell walls

Doable
For Farms, Bakeries, and Health

COALITION FOR GRAIN FIBER

PLANT BREEDING

- Building on 19 years research of commercial varietals
- Natural selection (non-GMO) with no yield loss
- Any region and wheat class
- Rapid introduction (5 years), with follow-on improvement
- Royalty free

END USE QUALITY

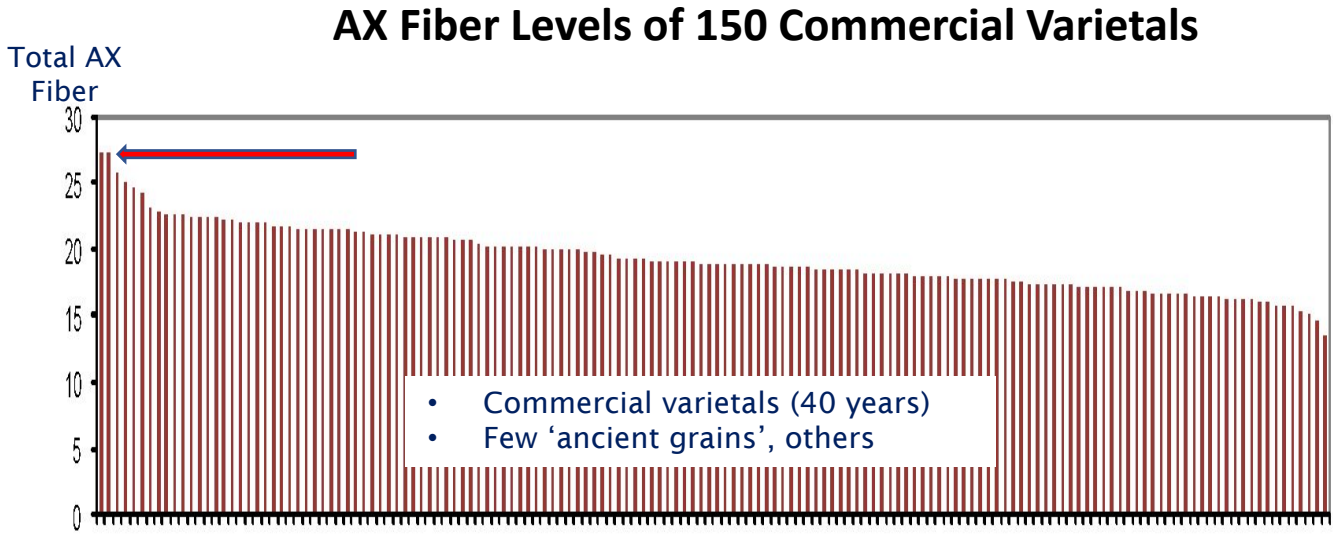
- Building on commercial varietals and decades of AX research
- HARD WHEAT: Commercial baking within commercial variation
- SOFT WHEAT: Best for doughy applications only

PUBLIC HEALTH

- Fiber is well-recognized as under-consumed nutrient of concern (US Dietary Guidelines, NASEM guidance)
- Modest increase, several times a day for billions of people
- No major side effects

Doable

For the Commercial Farm Without Yield Loss



- Building on 19 years of US and UK research on commercial varietals
- Natural selection (non-GMO) with no yield loss; 85% likely success
- Any region and wheat class
- Royalty free

Plant Breeding Characteristics

- High heritability: 60-70%
- Amenable to selection
- No long-term yield loss or agronomic impact identified

Doable
For Rapid Development

COALITION FOR GRAIN FIBER

- Rapid introduction (5 years), with follow-on improvement
- Royalty free

FIRST (Minimum Viable) PRODUCT: CURRENT VARIETALS

- UK
- US elite nurseries*
- Others

* 1st Commercialization by 2030

FOLLOW-ON OPTIMIZATION: BREEDING

- Increasing AX
- Executing back-crosses

Further Funding:

- Outlining un-accelerated and accelerated breeding (Winter, Spring, Soft)
- Estimated Budget: $0.9-4.0 million / year
- USDA NIFA grant submitted October 10

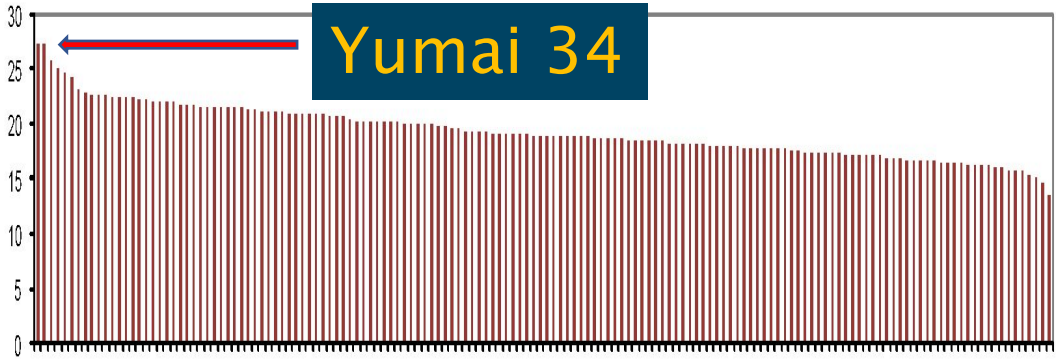
Doable

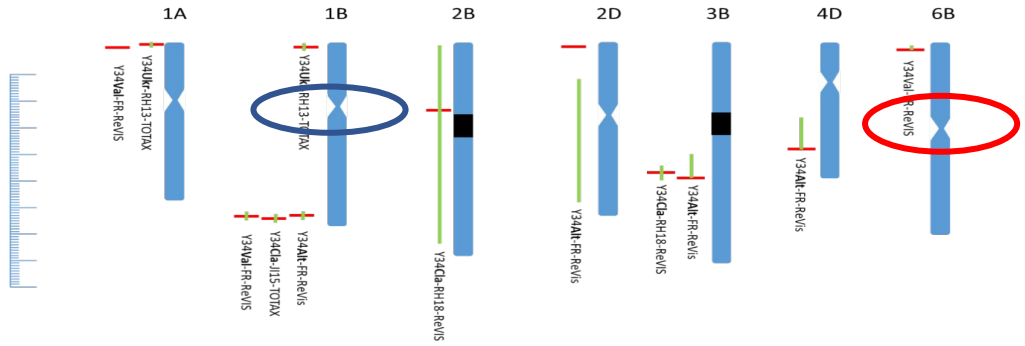
Without Yield Loss

19-Years of UK and 3 Years of US Research, on Commercial Varietals

Total AX: 1.4-2.8%

White flour: 150 lines





1B QTL: 16-24% of variation

6B QTL: 12% of variation

Primarily:

- 40 years of commercial varietals
- Currently common ‘ancient grains’

- High heritability: 60-70%
- Amenable to selection
- No long-term yield loss or agronomic impact identified
- Available royalty free

Doable
For the Commercial Bakery

- Building on commercial varietals and decades of AX research
- HARD WHEAT: Commercial baking within commercial variation
- SOFT WHEAT: Best for doughy applications only

END USE QUALITY CHARACTERISTICS

	Water Extractable AX	Water Unextractable AX
Hard wheat products (Bread)	Positive • Increase in bread volume • Increase in gas retention • Stronger dough • Uniform crumb • Decreases staling	Negative • Decrease in bread volume • Interferes with gluten formation
Soft wheat products (cookies, crackers)	Positive for doughy applications, as above	Negative as above
	Negative • High water competition	Negative • High water competition

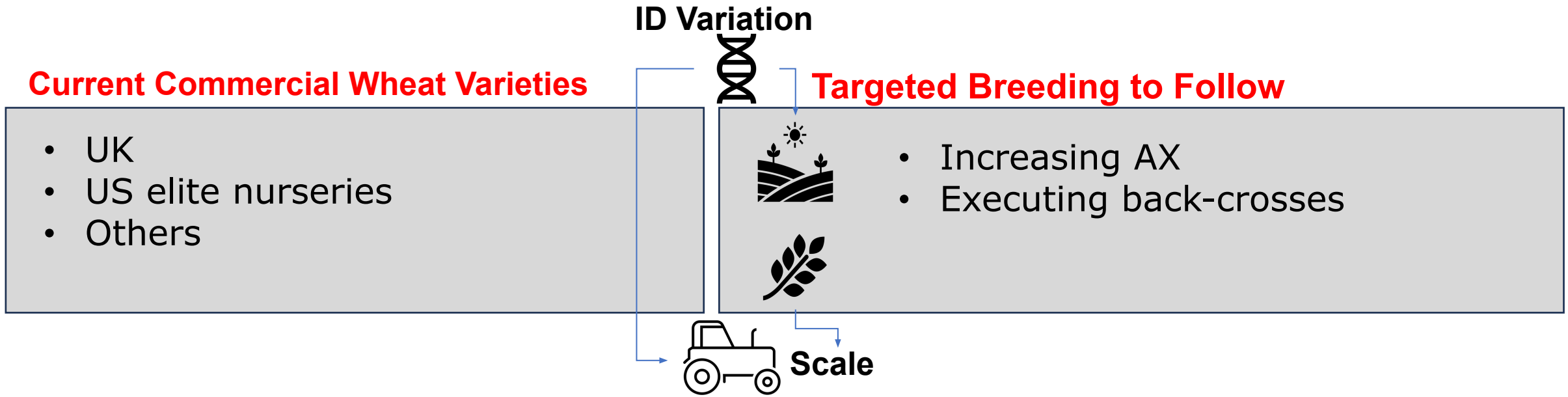
Kiszonas, A. et al 2013
Coalition scientist in Western Wheat Quality Lab; conducing wheat tests

Negative impact eliminated by common endo-xylanase enzymes

Further Funding:

- $140-230K / year budget
- Two USDA Grants Submitted

Doable
For Rapid Initial Development



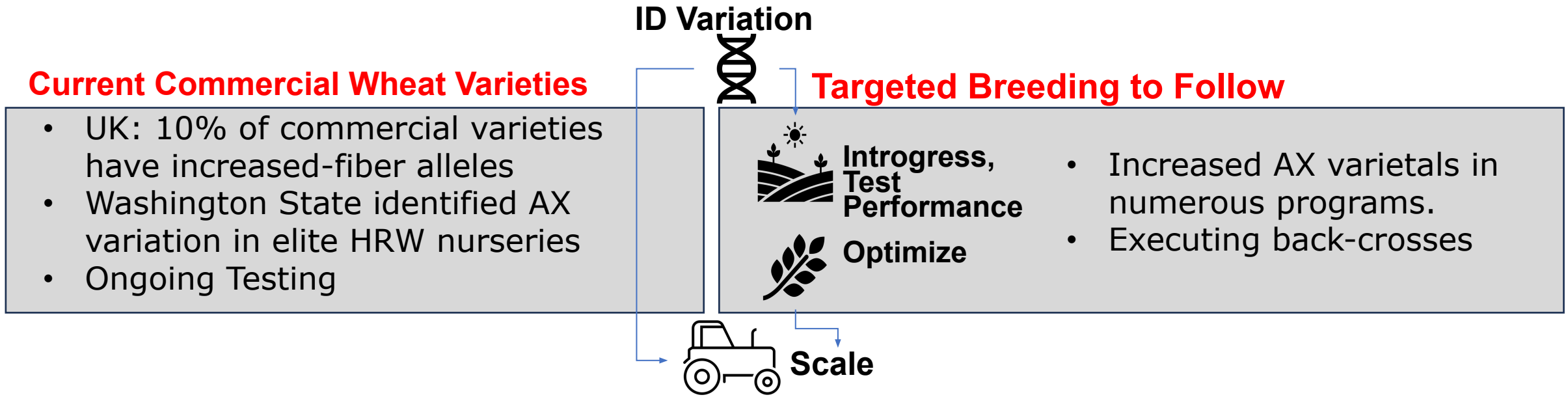
- 1st Commercialization by 2030

Funding:

- Outlining un-accelerated and accelerated breeding (Winter, Spring, Soft)
- Estimated Budget: $0.9-4.0 million / year
- USDA NIFA grant submitted October 10

Development Approach:
Existing Varieties Followed by Plant Breeding

COALITION FOR GRAIN FIBER



- Target 1st Commercialization by 2030

Funding:

- Outlining un-accelerated and accelerated breeding (Winter, Spring, Soft)
- Estimated Budget: $0.9-4.0 million / year
- USDA NIFA grant submitted October 10

Does The Wheat Bake Good Bread?

Yes: Positive for Doughy Applications, Although Negative for Dry, Soft Wheat Foods

Kiszonas, A. et al 2013

Coalition scientist in Western Wheat Quality Lab; conducing wheat tests

	Water Extractable AX	Water Unextractable AX
Hard wheat products (Bread)	Positive impact • Increase in bread volume • Increase in gas retention • Stronger dough • Uniform crumb • Decreases staling	Negative impact • Decrease in bread volume • Interferes with gluten formation
Soft wheat products (cookies, crackers)	Positive for doughy applications, as above	Negative as above
	Negative impact • High water competition	Negative impact • High water competition

Negative impact eliminated by common endo-xylanase enzymes

Science from Here:

- $140-230K / year budget
- Two USDA Grants Submitted

End-Use Quality (EUQ) Team

Deepening Knowledge to Understand and Minimize Impact of AX on Commercial Baking

COALITION FOR GRAIN FIBER

Arabinoxylan Measurement

Processing Impact on Arabinoxylan (TDF)

Agronomic, End-Use Quality Impact on hard, soft-wheat foods

Processing with different levels of xylanases

Activity underway includes:

- Measurement of AX, TDF
- Regional AX Trials
- Xylanase impact planning

Funding:

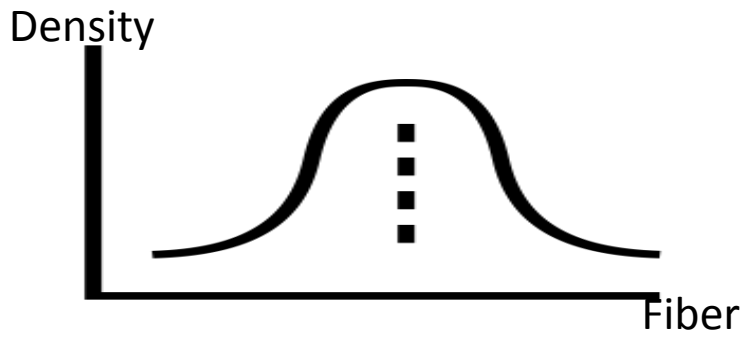
- $140-230K / year budget
- Two USDA Grants Submitted

Creating Higher-Value Grains

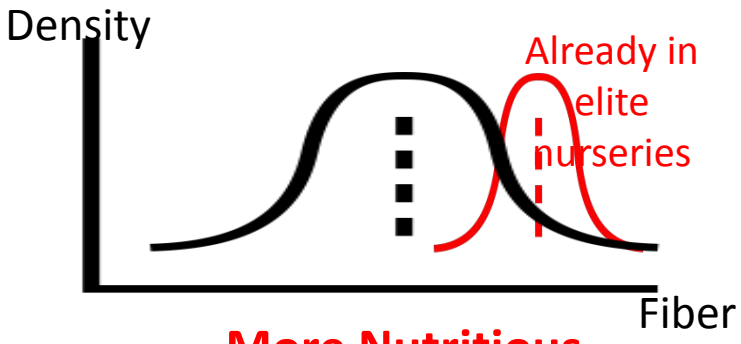
Increasing Average Fiber Level for a More Consistent Commodity

COALITION FOR GRAIN FIBER

Current



Transition



More Nutritious = Better

Less Variation

Further Improving

Doable
For Population Health

COALITION FOR GRAIN FIBER

Health Impact

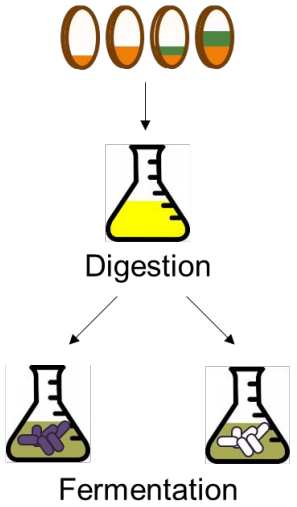
- "Under-consumption of dietary fiber is a **substantial public health concern** for the general U.S. population," (NASEM / Dietary Guidelines) A global challenge.
- Modest increase, several times a day for billions of people
- No major side effects

Communication

- We aim to communicate the population health effort:
  "Better wheat, better lives"
- Additional messages for some foods

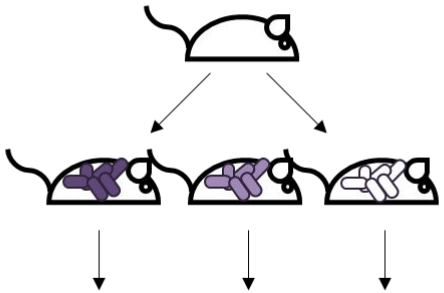
Ongoing CGF Science

In vitro test



Results consistent with hypothesis

Human microbiota-associated mouse study



Feed control low-fat (LF) diet or Western diet containing 30% wheat with varying fiber levels:

12 Weeks

Further Funding:

- $100K added mice funding needed
- Human trials / Small Dose Statistics

Well-Recognized, Under-Consumed Fiber
With Attractive Communication Targets

COALITION FOR GRAIN FIBER

Health Impact

- "Under-consumption of dietary fiber is a **substantial public health concern** for the general U.S. population," (NASEM / Dietary Guidelines) A global challenge.

- Ongoing CGF Science:
  - In vitro test complete
  - Mouse study prepping

Consumer Communication

- We aim for industry to be able to communicate the socially responsible effort: "Better wheat, better lives" (with precedent)

- If you create an identity-preserved chain:
  - We target support for Structure/ Function: 'Supports digestion / gut health'
  - Not current priority for disease reduction claim solely with AX increase
  - Not targeting "Added fiber" solely with increased AX

Is This First Step Enough?

A Step in the Right Direction for Billions of People

COALITION FOR GRAIN FIBER

- More fiber in every baked good (Up to 2.5 g/ day, average)
- We expect chronic disease will retreat:
  Nutrition Model*:
  - > Cardiovascular Disease **1-3%** ( )
  - > Diabetes type II **3-4.5%** ( )
- **$120** in benefits for each **$1** in cost**
- Lives saved from the first introduction of increased-fiber wheat

- A step towards next efforts and more commodities

*Actual reduction will depend on populations' actual diets
** 13-year investment and farmers' incentives vs healthcare cost savings and value of lives saved.

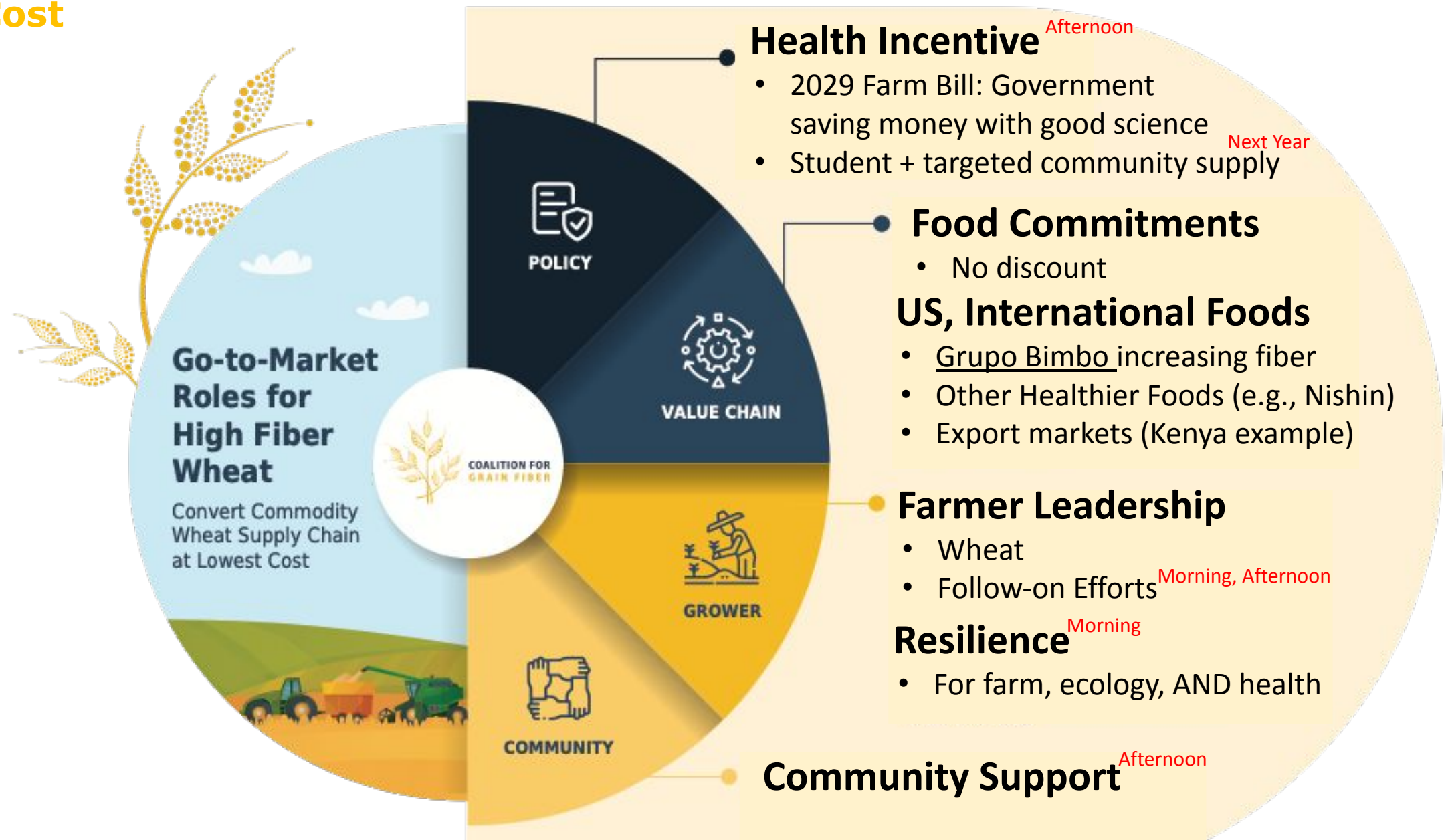
Agenda

COALITION FOR GRAIN FIBER

- Saving Lives at Global Scale
- Low-cost, World-Class Science
  - Doable, low-cost, life-saving study of commercial wheat
- Business Opportunity for Farmers
- How You Can Help

Bringing High-Fiber Wheat to-Market

Converting Commodity Supply Chain with Existing Business and Policy at Low Cost



Health Incentive Afternoon

- 2029 Farm Bill: Government saving money with good science
- Student + targeted community supply Next Year

Food Commitments

- No discount

US, International Foods

- Grupo Bimbo increasing fiber
- Other Healthier Foods (e.g., Nishin)
- Export markets (Kenya example)

Farmer Leadership

- Wheat
- Follow-on Efforts Morning, Afternoon

Resilience Morning

- For farm, ecology, AND health

Community Support Afternoon

Bringing Wheat to-Market, US Health/ Farm Policy

Pragmatic Health Policy in 2029 Farm Bill

COALITION FOR GRAIN FIBER

Health Incentive

Government saves money by investing in increased-fiber wheat

Key support:

- Farmer leadership
  - Afternoon Strategy Session on 2029 Farm Bill
- Value chain support
- Urban + rural communities devastated by chronic disease
- Dieticians, other scientists

No Discount for Increased-Fiber Wheat

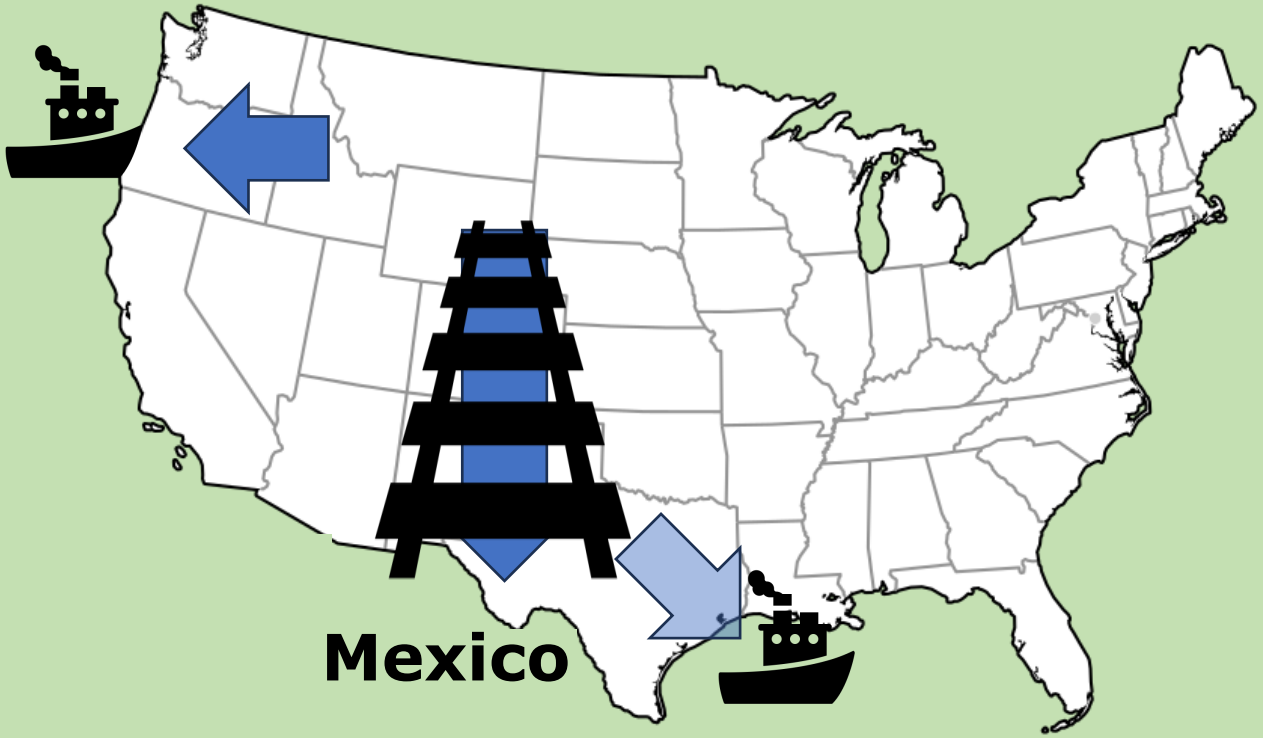
Follow-on Efforts

Support and scale from follow on opportunities in other commodities.

- Late Morning Discussion covering 51% of the US diet

Global Value Driving US Conversion, Beginning with Mexico

50% of Wheat Production is Exported



- Active Mexican food policy
- Grupo Bimbo announced fiber targets for 2030.

Others

Appear open to business case

US Exports	
Mexico	18%
Japan, Korea, Philippines, Taiwan	25%
China	6%
Nigeria	3%
Colombia	2%
Others	46%

* Distinctions between soft / hard wheat classes.

Bringing Wheat to-Market, Strategy 3

More Opportunities

COALITION FOR GRAIN FIBER

Traditional Healthy Products

- Options to deliver shareholder value with fiber standards and increased-fiber baked goods.
- With or without increased arabinoxylan fiber

Unique Supply Chains for Underserved Communities

- Options to deliver targeted nutritional value to underserved communities decimated by chronic disease

Resilience

- Revise ecosystem services targets to include harvested, increased-fiber wheat

Morning Session

Aligned Wheat Breeding

- Multiple Examples

The Coalition for Grain Fiber

Coordinated, Professional Activity at Low Cost

Coordinating Nutrient Research and Health Policy

Roles and Funds Work

Small

Foundation

Communicates and Coordinates Teams and Roundtables

Scientists

- Plant / Animal Breeding
- Nutrition / Health
- End-Use Quality
- Socio-Economics

Stakeholders

- Growers
- Policy
- Value Chain
- Community

Each expert does their own thing and funds their own thing (largely)

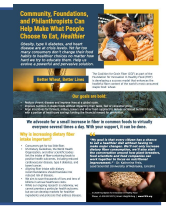
Strong reasons to participate:

- **A compelling reason for more money**
- **Introductions to new funders**
- **Save lives**

Ongoing Roundtable Calendar

Engaging Stakeholders

COALITION FOR GRAIN FIBER

Wheat Fiber for Rural Wealth and Health		Nov 7, ’24 Nebraska	https://fihf.org/events/
Successes and Failures Introducing Consumer Traits (Prior to Wheat Quality Council)		Feb 21 ‘25 Kansas City	
Grain Fiber to Combat Health Disparities in African American Communities, (with Historically Black Colleges and Universities)		Nov 3-4 ’25 Atlanta	
Nutritionists, Dieticians and Public Health		Oct ’25 TBD	

How You Can Get Involved

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Preparing a Path for Increased Nutrient Commodities

- Newsletter feedback (FIHF.org)
- Discussions at industry events
- Ongoing work

Stakeholder Advisers, Board Members

- More industry Advisors / Board E.g., active, retired

Collaborate on Roundtables

Raising Money

- Letters of Support for Grants
- Financial support
- Introductions to potential funders

Agenda

COALITION FOR GRAIN FIBER

- Saving Lives at Global Scale
  - Good science, financial incentives, and a world-class team
- Low-cost, World-Class Science
  - Doable, life-saving study of commercial wheat
- Building Financial Support
  - Policy and business strategy building on what's already there
- How You Can Help
  - We welcome time, talent, treasure– and introductions

Better Wheat, Better Lives.™

Questions

If your questions aren’t answered, please complete the survey:

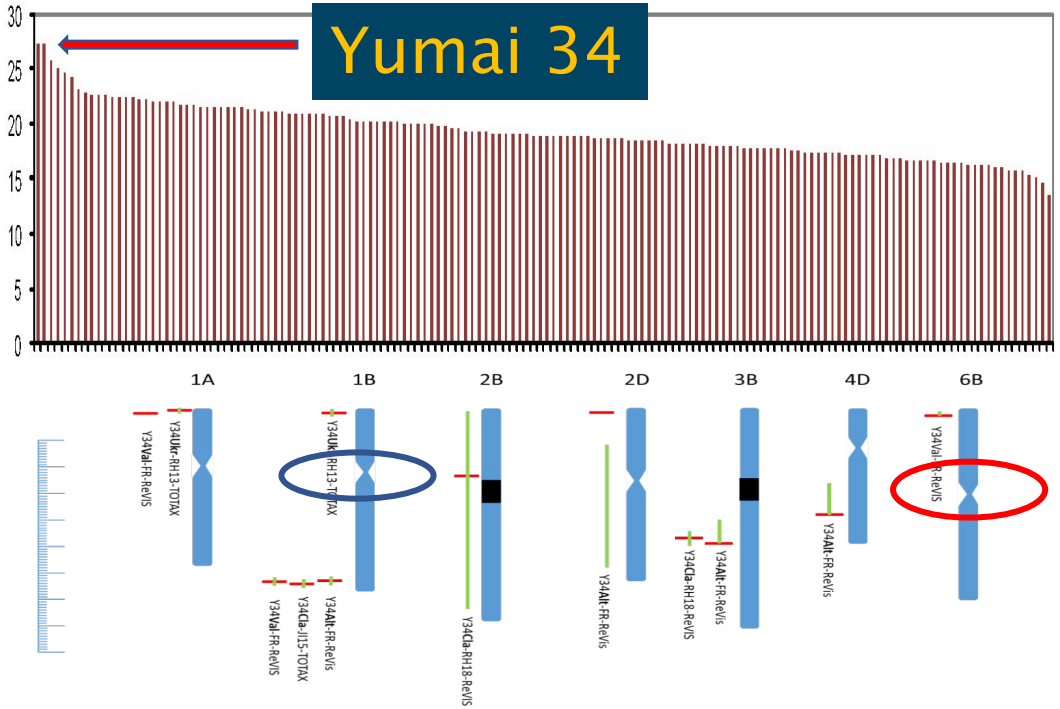
- What questions do you still have about what we’re doing?
- What questions do you think your neighbors would ask about CGF and follow-on projects?

15-Years of UK and 3 Years of US Plant Breeding Research:

Doable Without Yield Loss, At Low Cost

Total AX: 1.4-2.8%

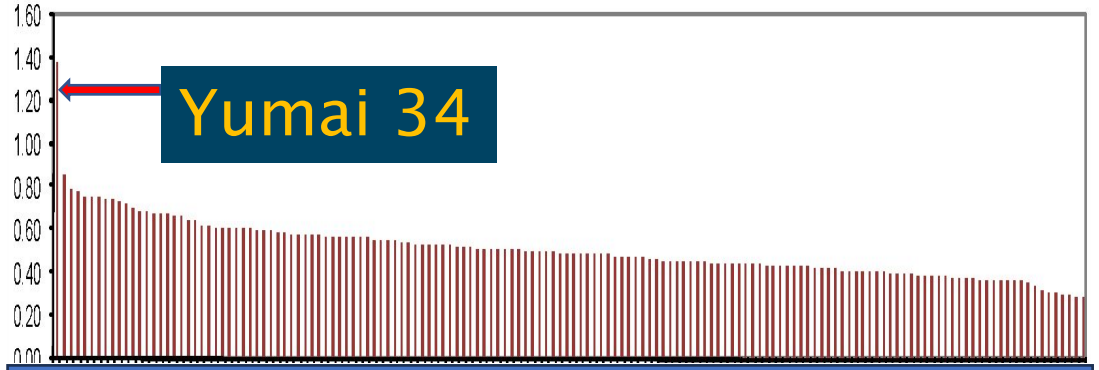
White flour: 150 lines



1B QTL: 16-24% of variation

6B QTL: 12% of variation

Soluble AX: 0.3-1.4%



- High heritability: 60-70%
- Amenable to selection
- No long-term yield loss or agronomic impact identified
- Available royalty free

Is this enough?

A Step in the Right Direction for Billions of People

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

- Everyone who eats wheat gets more fiber (Up to 2.5 g/ day, average)
- We expect chronic disease will retreat:
  Nutrition Model*:
  - Cardiovascular Disease 1-3% ( )
  - Diabetes type II 3-4.5% ( )
- $120 in benefit for each $1 in cost**
- Even a little high-fiber wheat helps– and a lot helps a LOT

US Cost and Benefits	Year 0	2	4	6	8	10	12	14	Total
Healthcare Cost Savings ($MM)	255	3,402	5,104	6,805	8,506	10,207	11,909	11,909	58,097
US Lives Saved (#)	387	5,158	7,737	10,316	12,894	15,473	18,051	18,051	88,067
% of US Crop High-Fiber (50% delivered to US)	1.5%	20%	30%	40%	50%	60%	70%	70%	

*Actual reduction will depend on populations' actual diets

** 13-year investment and farmers' incentives vs healthcare cost savings and value of lives saved.

Overview

Why a New Paradigm? Wheat Fiber for Rural Wealth and Health in Nebraska?

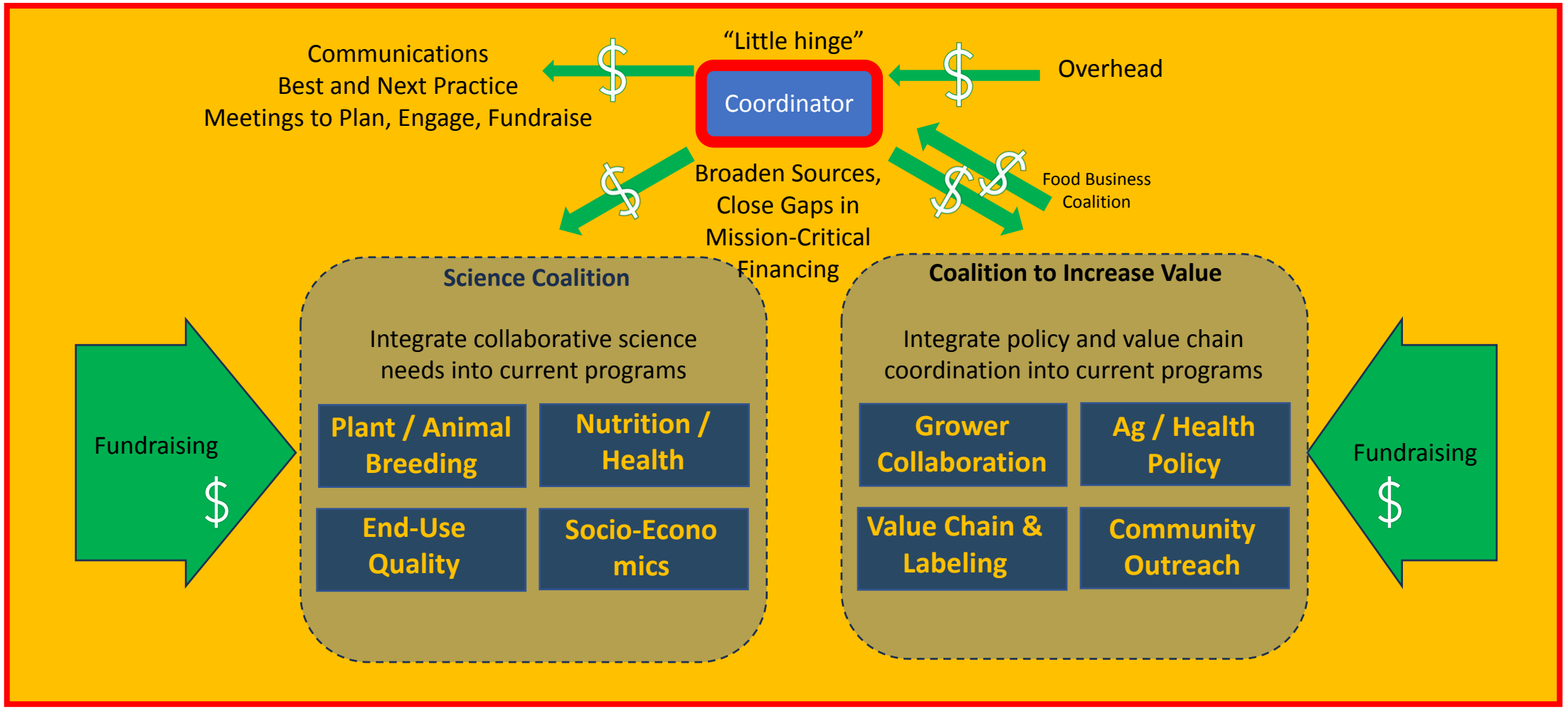
We aim to build alignment around a clear plan to enhance rural wealth and health by connecting agriculture and public health.

Why Nebraska?

- #1 ag economy
- Political leaders dedicated to agricultural interests and helping people live better lives
- University of Nebraska thought leadership, including:
  - Nebraska Food for Health Center at the University of Nebraska linking agriculture and food production to wellness and disease prevention
  - 10 UNL and UNMC faculty participating in the Coalition for Grain Fiber
  - Highly respected University of Nebraska Extension Human Sciences Program
- Nebraska Wheat's commitment to innovatively developing wheat markets

Coordinating Nutrient Research and Health Policy

How Roles and Funds Work



Public Health Strategy
A Paradigm Shift Learned from History

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Food-for-Healthier Lives

Simple Fortifications Delivered Great 20th Century Advances

- Fluoridated water: cut cavities
- Fortified white flour: reduced birth defects
- Vitamin D dairy: nearly eradicated rickets

While gaps between real world diets and established Guidelines are large, we recognize and respect that culture drives distinct food desires.

Our Attractive Choices

Modest nutrition increases in common foods eaten by virtually everyone several times a day. Easier to implement than might be expected.

Top 3 Foods' Diet Share

Global 66% **US** 33%

- Celebrate culture and individual tastes without relying on consumer behavior change.
- Enhance nutrients in intact foods
- Non-GMO wheat
- Embrace environmental values

Financial incentives to be generated where needed, aligned with current disease prevention and ag policy

A Low-Cost, Doable Approach To Enhance Health

Success Likelihood: 85% (as of Feb)

PLANT BREEDING

- 15-years of UK + 3 Years US science
- Plant breeding approach without yield loss at low cost– based on natural selection (non-GMO)
- Can be integrated in any region and class of wheat
- Our approach features rapid varietal selection of existing commercial varieties and elite nursery varieties (5 years), with follow-on improvements
- Trait is available royalty free, to any interested party

END USE QUALITY

- Building on decades of AX wheat research
- HARD WHEAT: Impacts within normal variation
  - ✔ Acceptable baked goods (organoleptics US, UK)
  - ✔ Most quality impacts positive (retains moisture)
  - ✔ Negative can be largely eliminated by common endo-xylanase enzymes
- SOFT WHEAT: Possibly doughy applications only
- Ongoing science adds comfort, ensures ability to successfully adjust production and supply chain

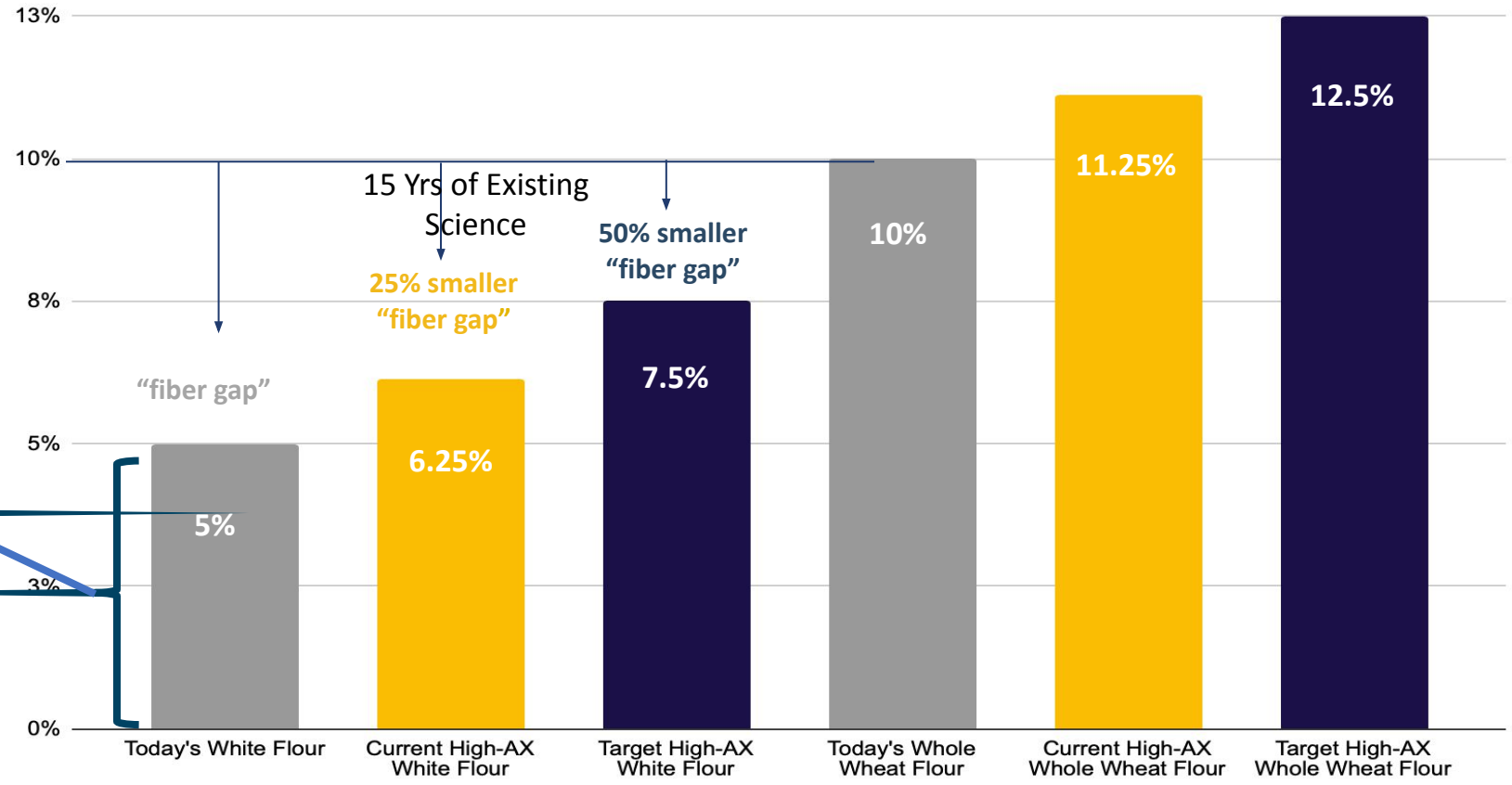
PUBLIC HEALTH

- Under-consumed nutrient of concern (US Dietary Guidelines, NASEM guidance), Global need
- Modest increase, several times a day, billions of people
- No major side effects

Nature's Opportunity
To Increase Wheat Fiber in White Flour and Whole Grain

Arabinoxylan (AX)	1.4-2.8%
Beta Glucan	0.25-0.75%
Total Cell Well Polysaccharides	2-3%
+ Fructans	1.5%
Arabinogalactin Peptide	up to 0.4%
Total Fiber	**4.3%**
+ Resistant starch	0.7%
Total Bread Fiber	**5%**

Based on Shewry, P. and Hey (2015), The contribution of wheat to human diet and health.



Endoxylanase Enzymes

Eliminates negative doughy application impacts

COALITION FOR GRAIN FIBER

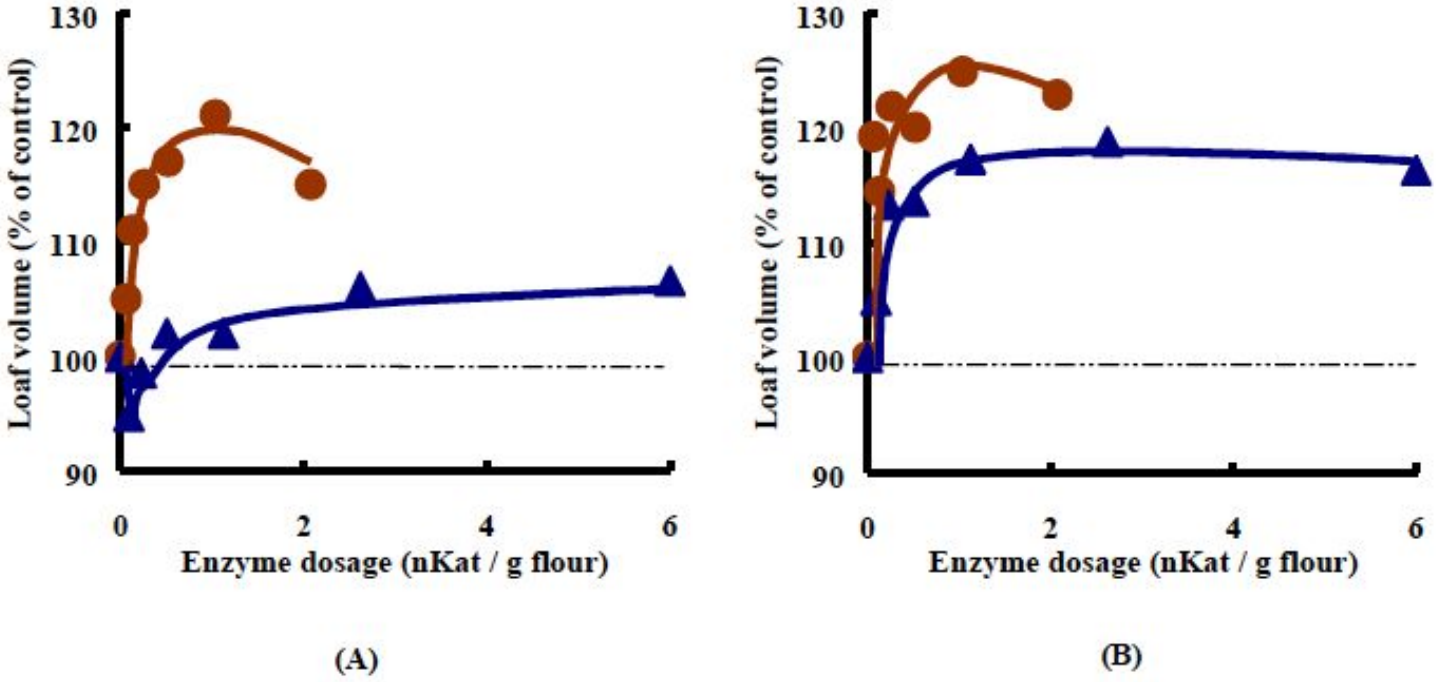


Figure VI-1: Specific loaf volume as a function of (--●--) XBS and (--▲--) XAA dosage for (A) flour A and (B) flour B.

Courtin, C. 2000

Low-Risk Plant Breeding and End Use Qu

85% Probability of Technical Success

COALITION FOR GRAIN FIBER

9 Plant Breeders and 9 EUQ Specialist Anonymized Survey During Feb '24 Workshop

Plant Breeding

Fiber Increase % in White Flour (Median Response)

25% Increase	50% Increase
85%	60%

"If 25% commercial lines already exist, then making them in the US is almost guaranteed."
10% of commercial UK varieties with increased-fiber genes

Genes also present in commercial varieties in China, France

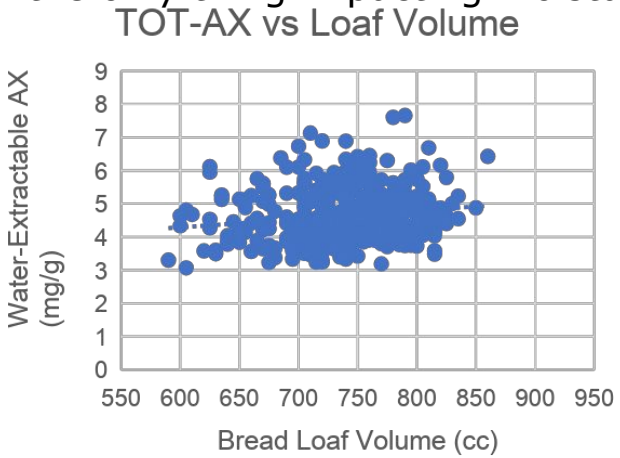
"I'm slightly more confident after our discussions today that we have the tools and germplasm to develop high quality 50% fiber increase, especially if we look beyond AX."

End-Use Quality

Fiber Increase % in White Flour (Median Response)

25% Increase	50% Increase
95%+	95%+

"25% increase is very close to higher AX content observed currently and would not require too much changes."
AX is NOT the only thing impacting moisture, e.g.,:

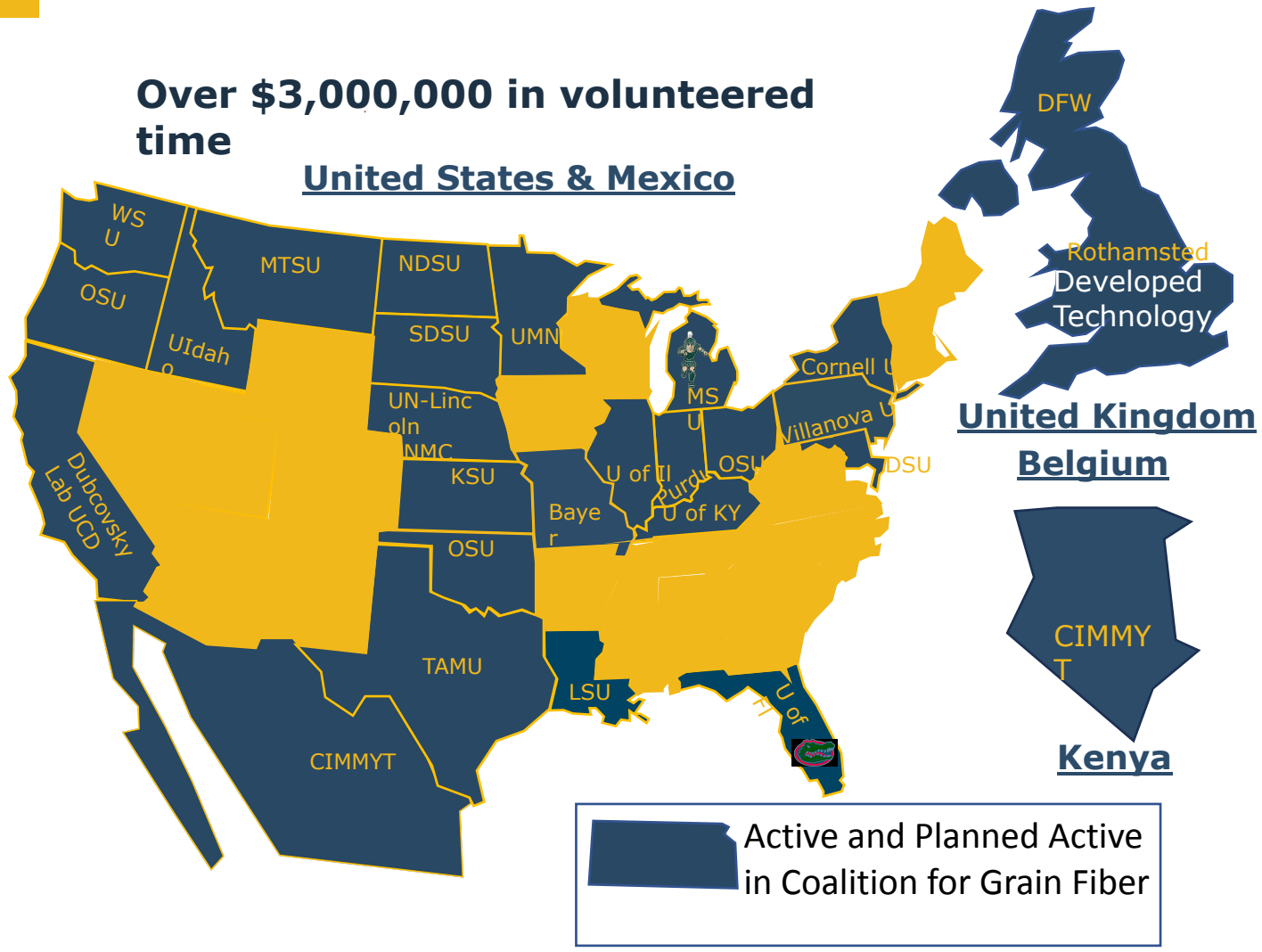


"More work is needed on formulation and process adaptations. Science and industry can achieve this with adequate funding support." "We have the technology toolbox to make a decent bread."

World-Class, Multinational Team
Dedicated to Transforming Food

COALITION FOR GRAIN FIBER

Over $3,000,000 in volunteered time



Over 50 Laboratory Leaders

25 States and 5 Nations

27 Full Professors

6 Distinguished Professors

1 Winner of the Wolf World Award for Agricultural Science

WOLF FOUNDATION

Research endorsed by Nobel Peace Laureate

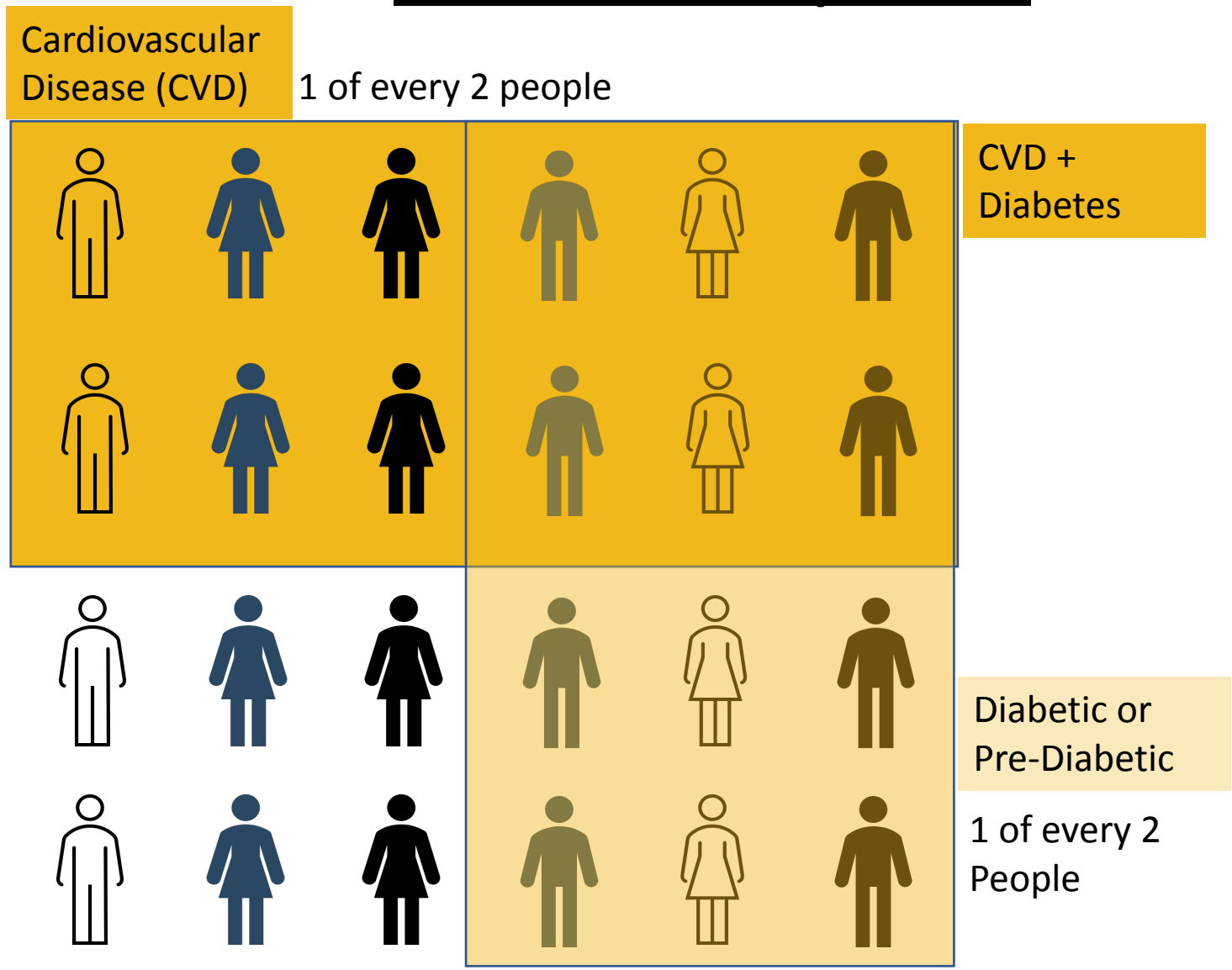
Over 15 Leading Professionals from

McKinsey & Company · Cargill · AkzoNobel · Vanguard Charitable · Grupo Bimbo · Bayer · USDA · Bay State Milling · National Association of Wheat Growers · Ferrero Rocher

National and Global
Overwhelming Challenges

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Indicative US Population



Nebraska in Focus

Chronic Disease Costs Billions and Kills Millions

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4679631/

Go-to-Market Approach

What Drives High-Fiber Wheat Demand?

COALITION FOR GRAIN FIBER

Policy

Health Incentive

Government pays for certified increased-fiber wheat seed

Key support:

- Farmers + value chain support
- Urban + rural communities devastated by chronic disease
- Dieticians, other scientists

Value Chain Commitments

No discounts increased-fiber grain

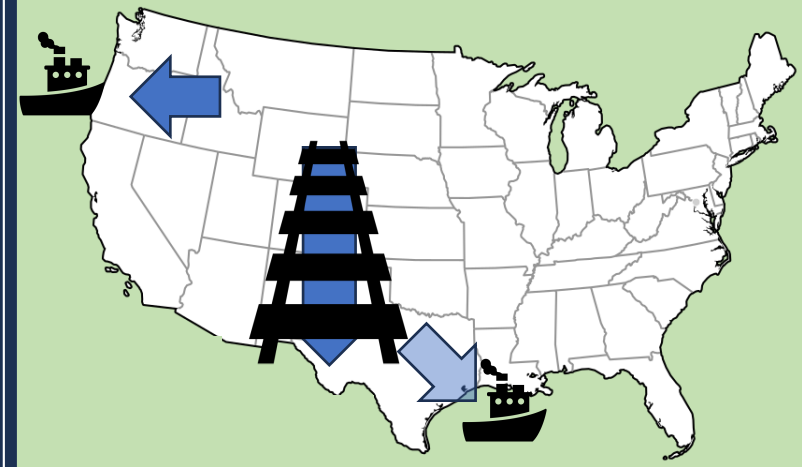
Follow-on Efforts

Support and scale from follow on opportunities in other commodities.

Global Value

Mexico

- Mexican food requirements
- Grupo Bimbo announced fiber targets for 2030.



Others

Appear open to business case.

More Opportunities

Traditional Healthy Products

Options to deliver shareholder value with fiber standards and increased-fiber baked goods.

Resilience

Revise ecosystem services targets to include harvested, increased-fiber wheat

Aligned Wheat Breeding

Durum wheat heavy metals model

Go-to-Market Approach

What Drives High-Fiber Wheat Demand

COALITION FOR GRAIN FIBER

Health Incentive

Government pays for certified increased-fiber wheat seed (X% of cost)

Key support:

- Farmers
- Impacted urban and rural communities devastated by chronic disease
- Nutritionists, dieticians, other scientists
- Others

Food Commitments

Baking industry welcomes increased-fiber grain at commodity prices; no fiber discount.

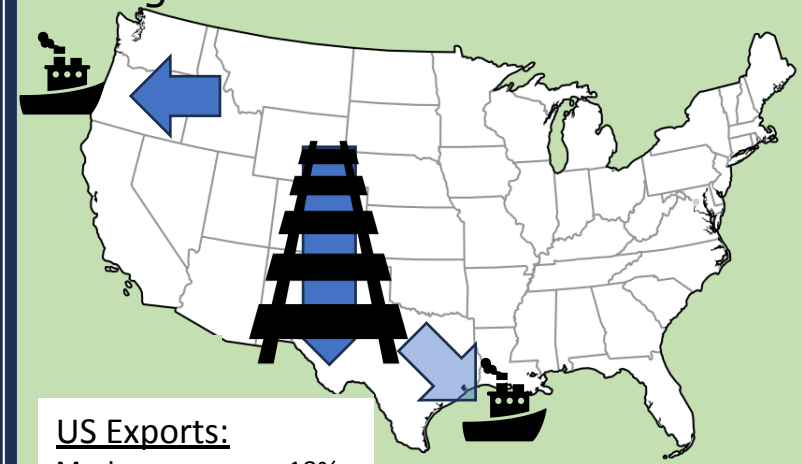
Follow-on Efforts

Further increased-nutrient efforts in wheat, other foods expands support and scale.

International Support

Mexican government actively supports healthier foods.

<u>Grupo Bimbo announced</u> minimum dietary fiber content targets for 2025 and 2030.



<u>US Exports:</u>

Mexico	18%
Japan, Korea, Philippines, Taiwan	25%
China	6%
Nigeria	3%
Colombia	2%
Others	46%

Japan has existing 'for gut health arabinoxylan fiber food'

Resilience

Revise ecosystem services targets to include harvested increased-fiber wheat in government supported rotational cropping systems to foster soil health, thus coupling efforts to reduce chronic disease with improving soil health, reducing soil erosion, chemical and moisture runoff, and increasing biodiversity.

Baking Opportunities

Specific businesses find value in committing to increase fiber standards for their baked goods, and/or higher-fiber product opportunities, accelerating the pull.

Aligned Wheat Breeding

Wheat breeders may find grant value in increased fiber varieties and committing to increase average fiber level. (Durum wheat heavy metals model)

Low-Risk Arabinoxylan Science

85% Probability of Technical Success

COALITION FOR GRAIN FIBER

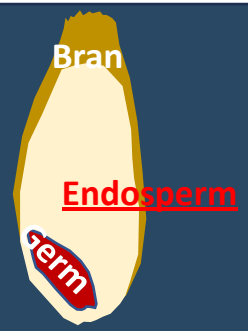
Plant Breeding

Fiber Increase % in White Flour (Median Response)

25% Increase	50% Increase
85%	60%

- Non-GMO natural variation (no approvals)
- 2 QTLs in UK, France, China bread wheat varieties
- High heritability (60-70%)
- No long-term yield loss or other agronomic impact
- 5 + year development

- Can be integrated in any region's wheat
- Available royalty free, to any interested



Arabinoxylan

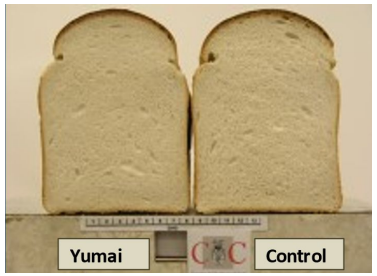
Fiber in endosperm cell walls remains in white flour, whole grain foods; 25-50% increase in white flour and whole grain fiber 'Stackable' trait

Increases under-consumed nutrient of concern
No major side effects

End-Use Quality

Fiber Increase % in White Flour (Median Response)

25% Increase	50% Increase
95%+	95%+



UK Bread Test

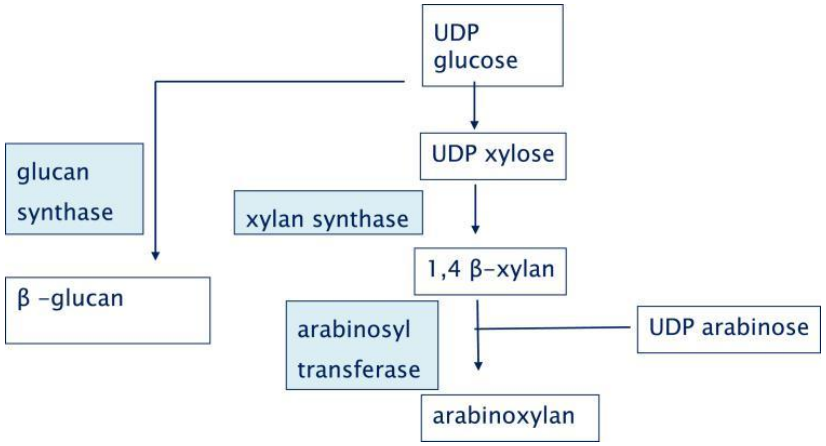
- HARD WHEAT: Acceptable bread for US, UK baking:
  - ✔ Less impact than shift old to new crop
  - ✔ Aim for NOT identity preserved
- SOFT WHEAT: Potentially for doughy applications only

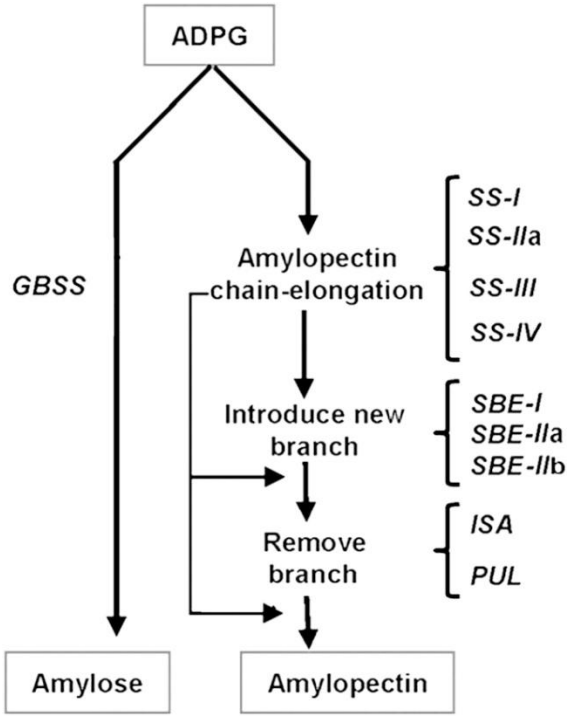
Survey of 9 Plant Breeders and 9 EUQ Specialist Anonymized Survey During Feb '24 Workshop

Future Fiber Research

COALITION FOR GRAIN FIBER

- Fiber in wheat
  - Cell Wall
    - Cellulose
    - **Arabinoxylan**
    - **Beta-glucan**
    - Lignin
    - Glucomannan
  - Fructan (FODMAPS)
  - **Resistant Starch**
- November 7th Discussion on Next Options: Wheat; Rice; Corn; Animal-Based Foods





Lafiandra, D. et al. 2014

End-Use Quality (EUQ)

Multiple, Ongoing Activities

COALITION FOR GRAIN FIBER

Arabinoxylan Measurement

Processing Impact on Arabinoxylan (TDF)

Agronomic, End-Use Quality Impact on hard, soft-wheat foods

Processing with different levels of xylanases

Activity underway includes:

- NIR calibration for ground meal and flour
- Measuring TDF in bread
- Regional AX Trials (West, East, South, North): uniformity and performance
- Evaluate processing quality with endogenous and exogenous xylanases

Funding:

- Three-year budget $140-230K / year

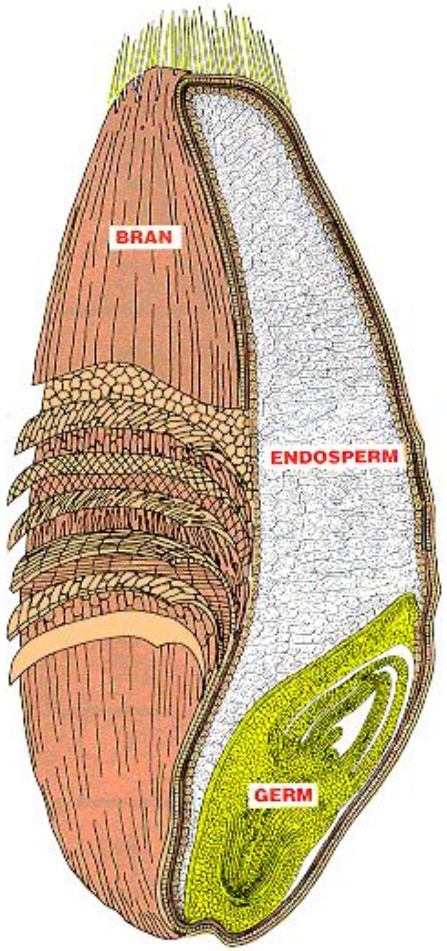
USDA NIFA grant submitted Oct 10
USDA AFRI Novel Foods Grant submitted Oct 1
Private organization interested in funding sensory test

We are answering a limited– but important– set of open EUQ questions

Fiber Amounts

COALITION FOR GRAIN FIBER

Wheat Fiber	White Flour	Whole Wheat Flour
Arabinoxylan	1.2%	5.4%
	0.8%	1.8%
Cellulose	-	1.4%
Glucomannan	0.2%	0.2%
Lignin	-	0.4%
Fructan	0.8%	2.4%
Resistant Starch (high amylose)		
Total Fiber	**3.0**	**11.6**

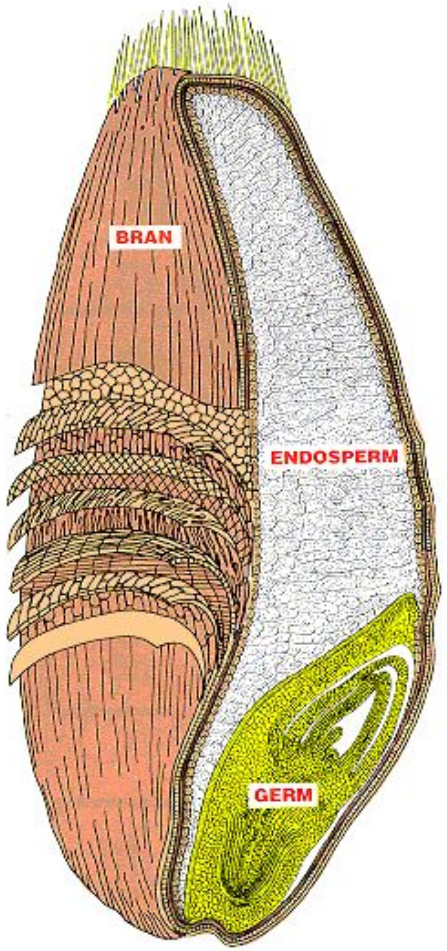


Shewry, P. 2013, Struyf, N. et al. 2017, Finnie, S. et al. 2006, USDA National Nutrition Database SR26

Fiber Amounts

COALITION FOR GRAIN FIBER

Wheat Fiber	White Flour	Whole Wheat Flour
Arabinoxylan	1.2%	5.4%
	0.8%	1.8%
Cellulose	-	1.4%
Glucomannan	0.2%	0.2%
Lignin	-	0.4%
Fructan	0.8%	2.4%
Resistant Starch (high amylose)	0 to >25%	0 to >25%
Total Fiber	**3.0 to >25%**	**11.6 to >25%**

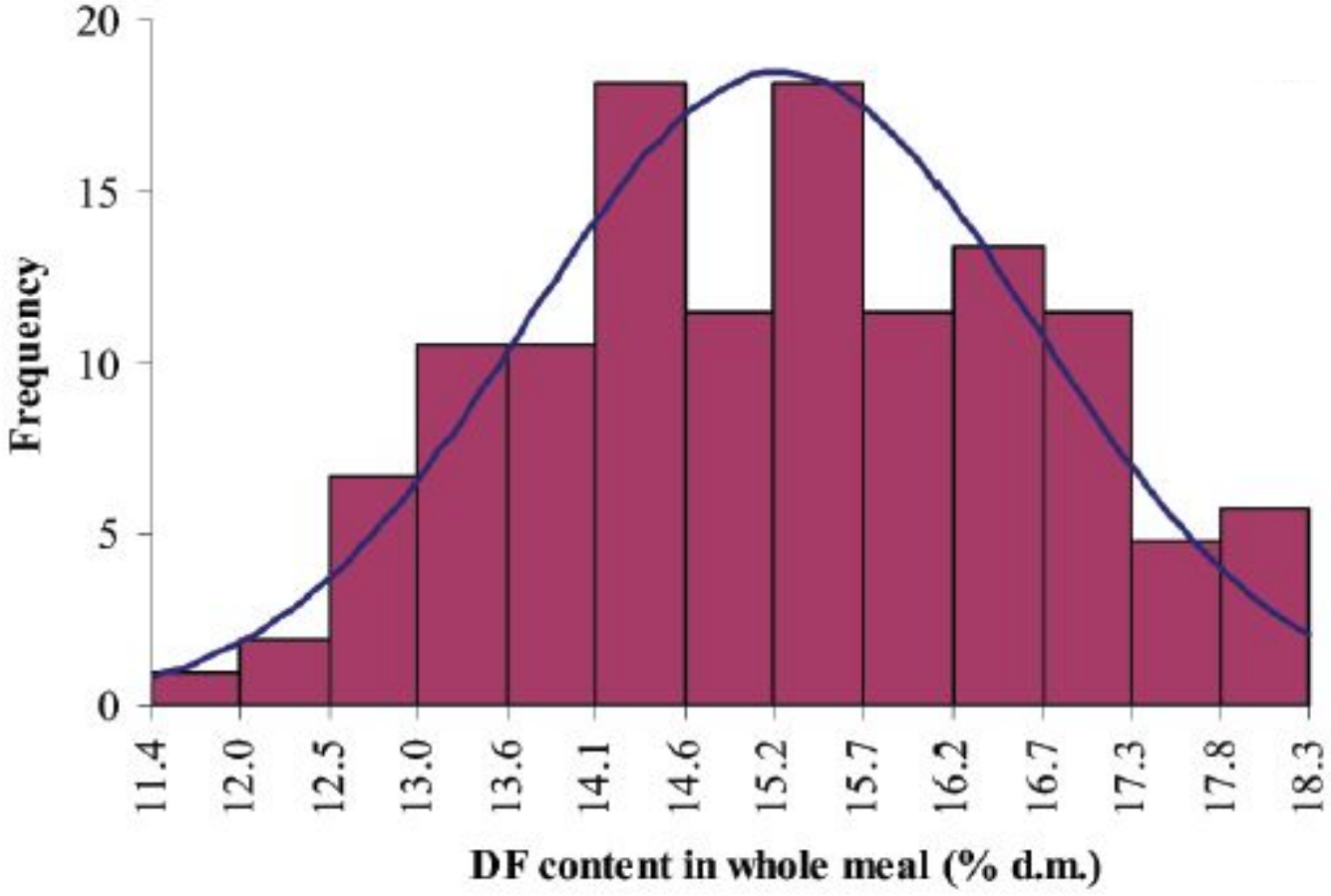


Shewry, P. 2013, Struyf, N. et al. 2017, Finnie, S. et al. 2006, USDA National Nutrition Database SR26

Healthgrain Study

Whole Wheat Fiber

COALITION FOR GRAIN FIBER

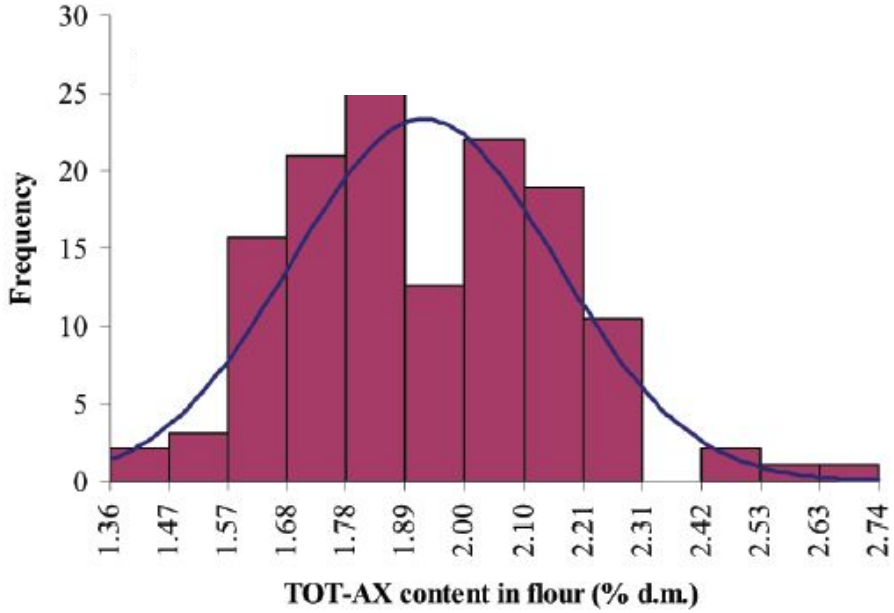


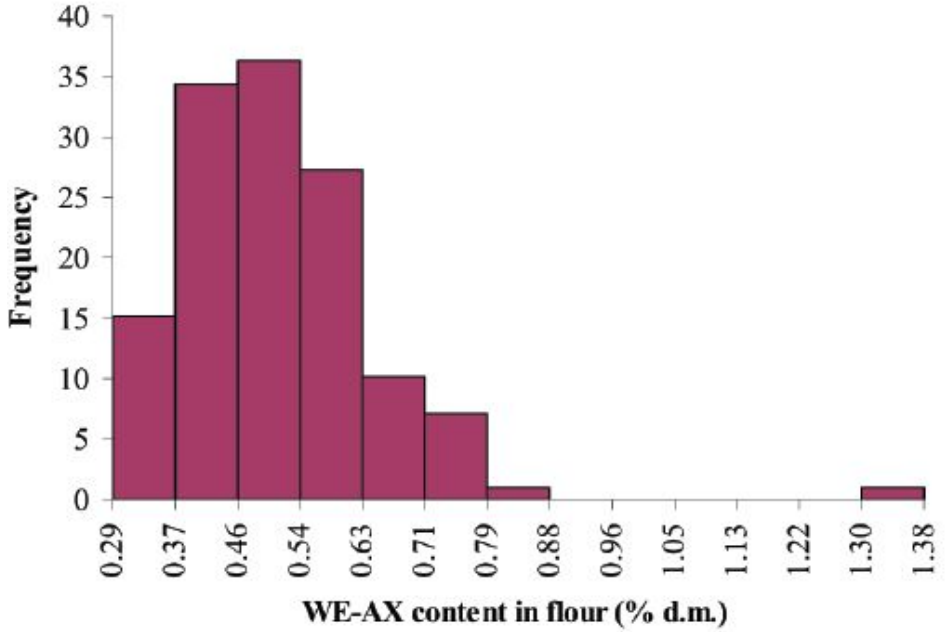
Gebruers, K. et al. 2008

Healthgrain Study

Arabinoxylan

COALITION FOR GRAIN FIBER



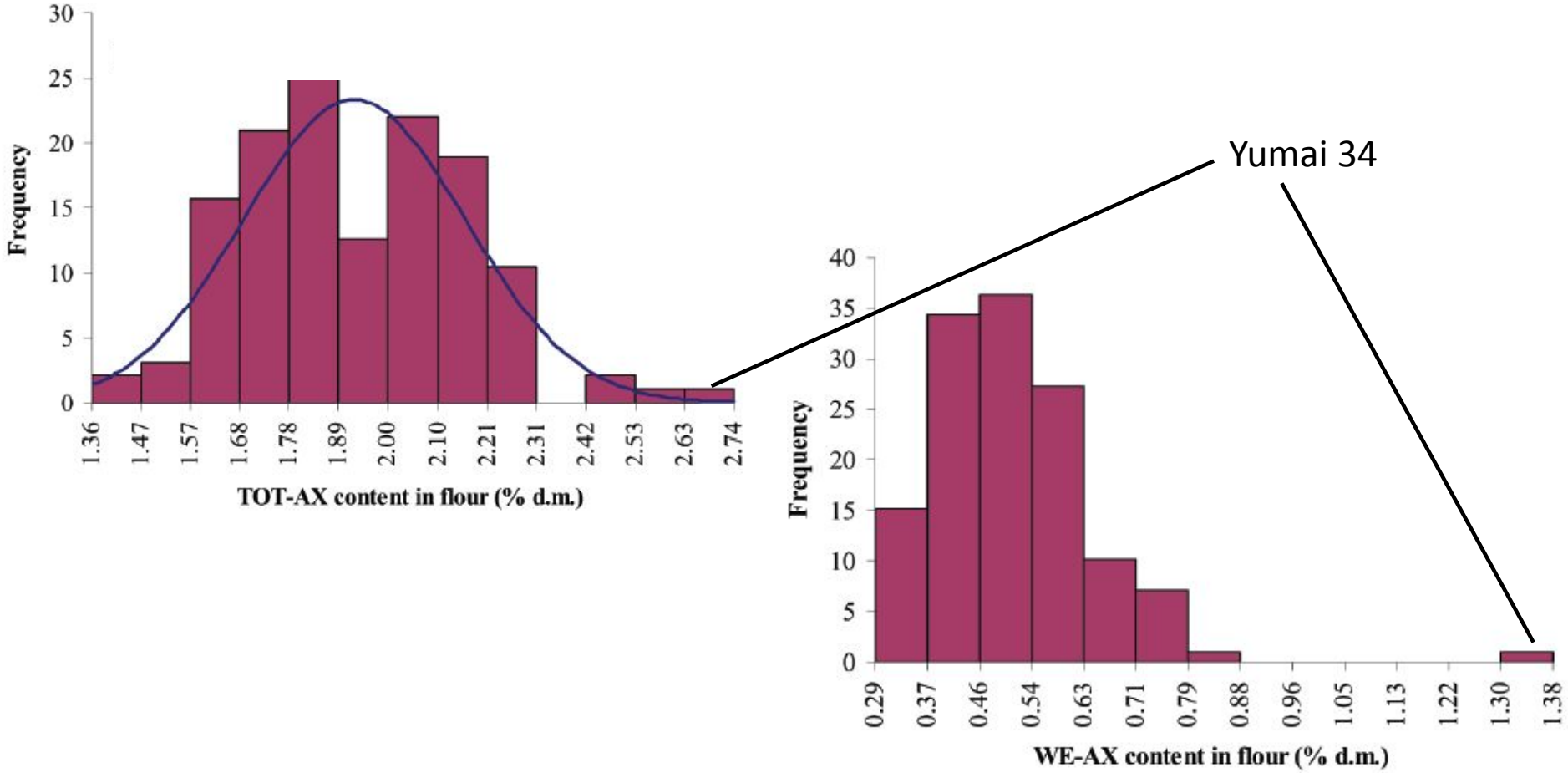


Gebruers, K. et al. 2008

Healthgrain Study

Arabinoxylan

COALITION FOR GRAIN FIBER

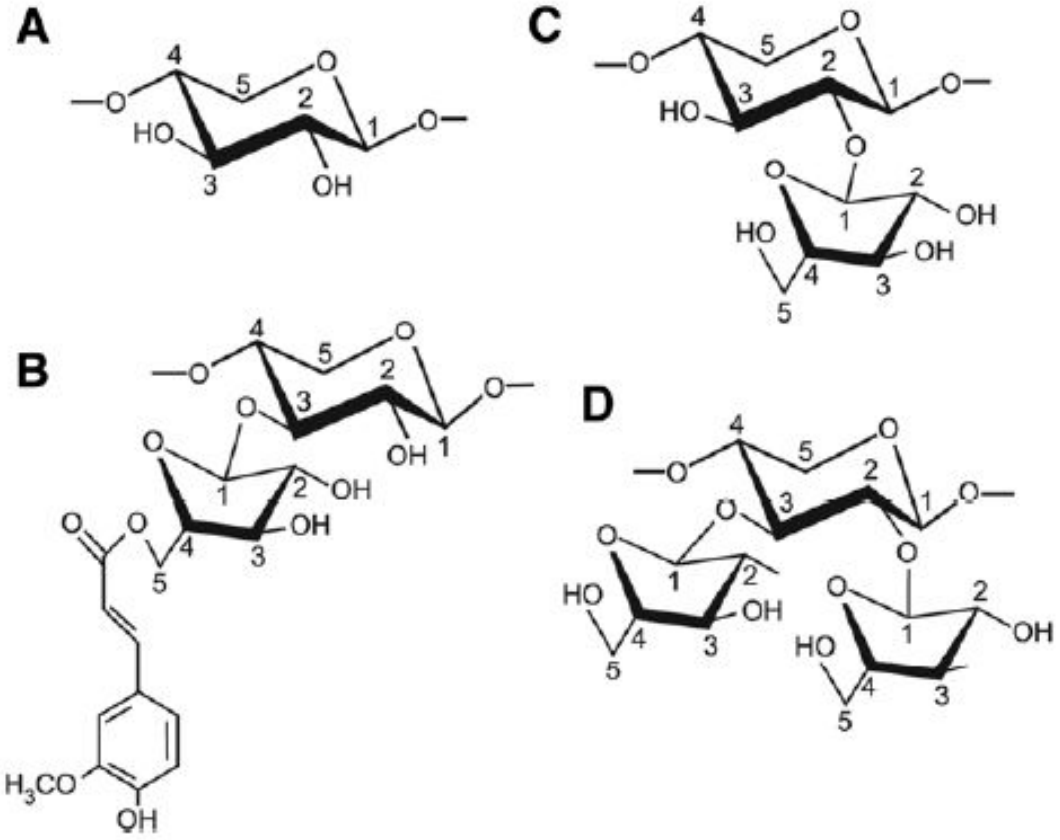


Gebruers, K. et al. 2008

Structure of Arabinoxylan

Arabinoxylan

- β 1-4 linked D-xylose units as the backbone (A)
  - Monomeric α-L-arabinose units linked at the 2 and/or 3 carbon position. (C & D)
  - Ferulic acid can be bound to arabinose at the 5 carbon position (B)



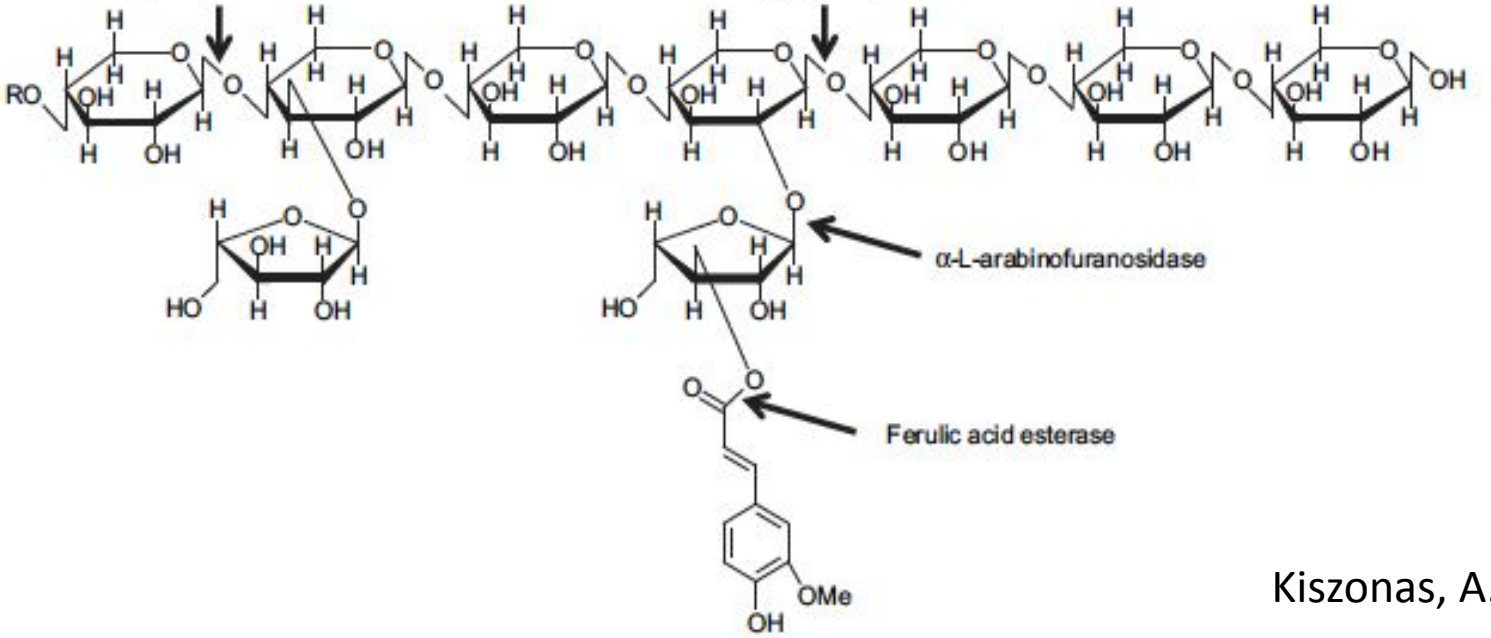
Kiszonas, A. et al. 2013

Structure of Arabinoxylan

Arabinoxylan

Degree of substitution and pattern of substitution determines water solubility

Water Unextractable Arabinoxylans (WUAX)
Water Extractable Arabinoxylans (WEAX)

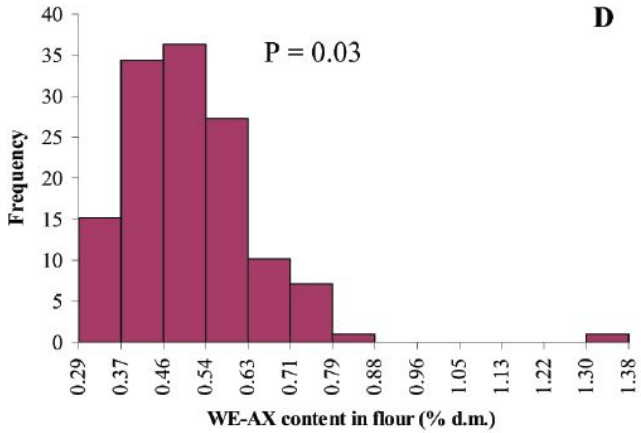


Kiszonas, A. et al. 2013

Sources of Variation

Arabinoxylan

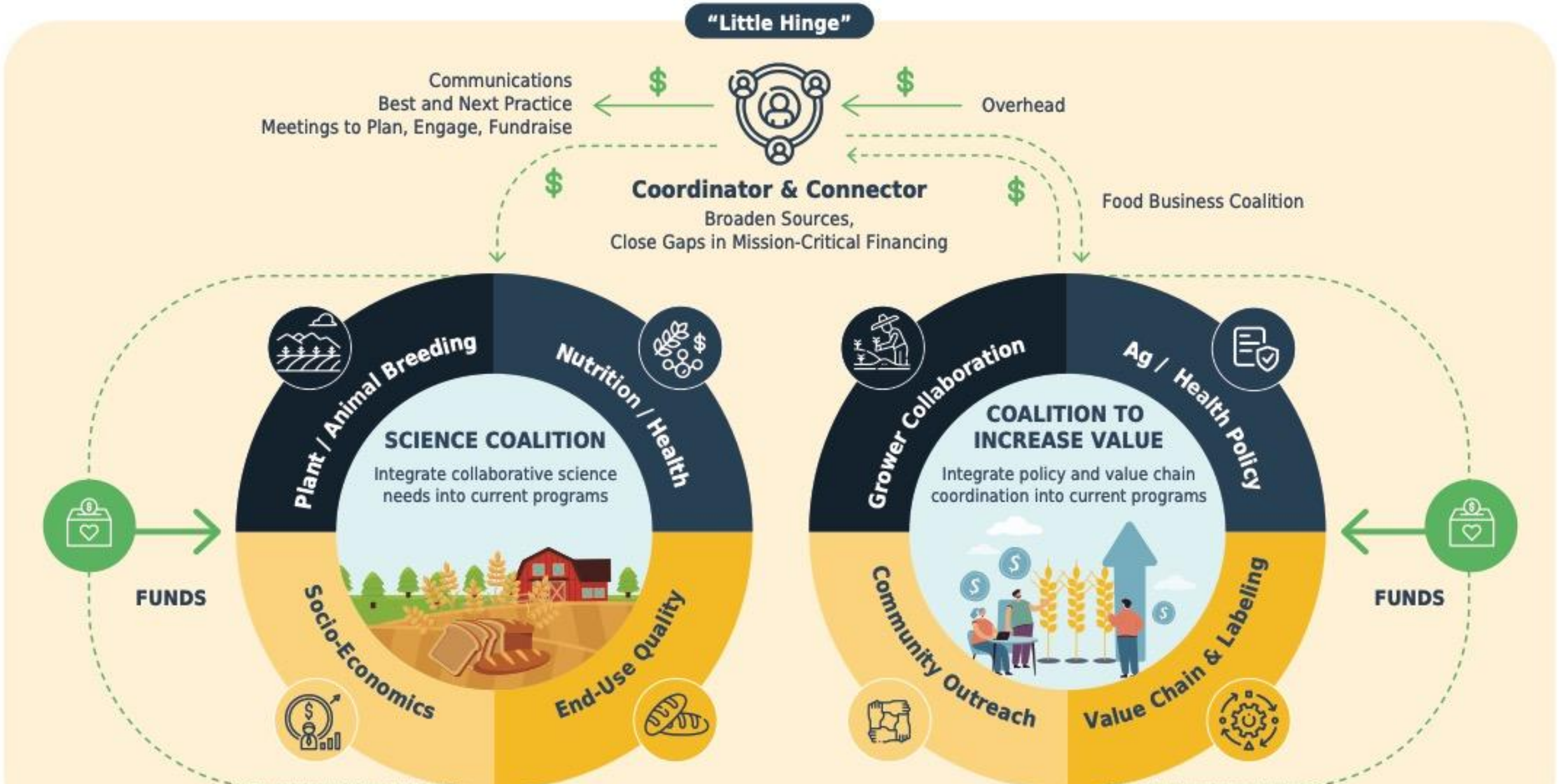
COALITION FOR GRAIN FIBER



- High levels of hereditability
  - Total arabinoxylans
  - Water extractable arabinoxylans
- Environment also has an influence on arabinoxylan content
- In general, Genetics have a greater impact on WEAX and Environment has a greater impact on WUAX and TAX

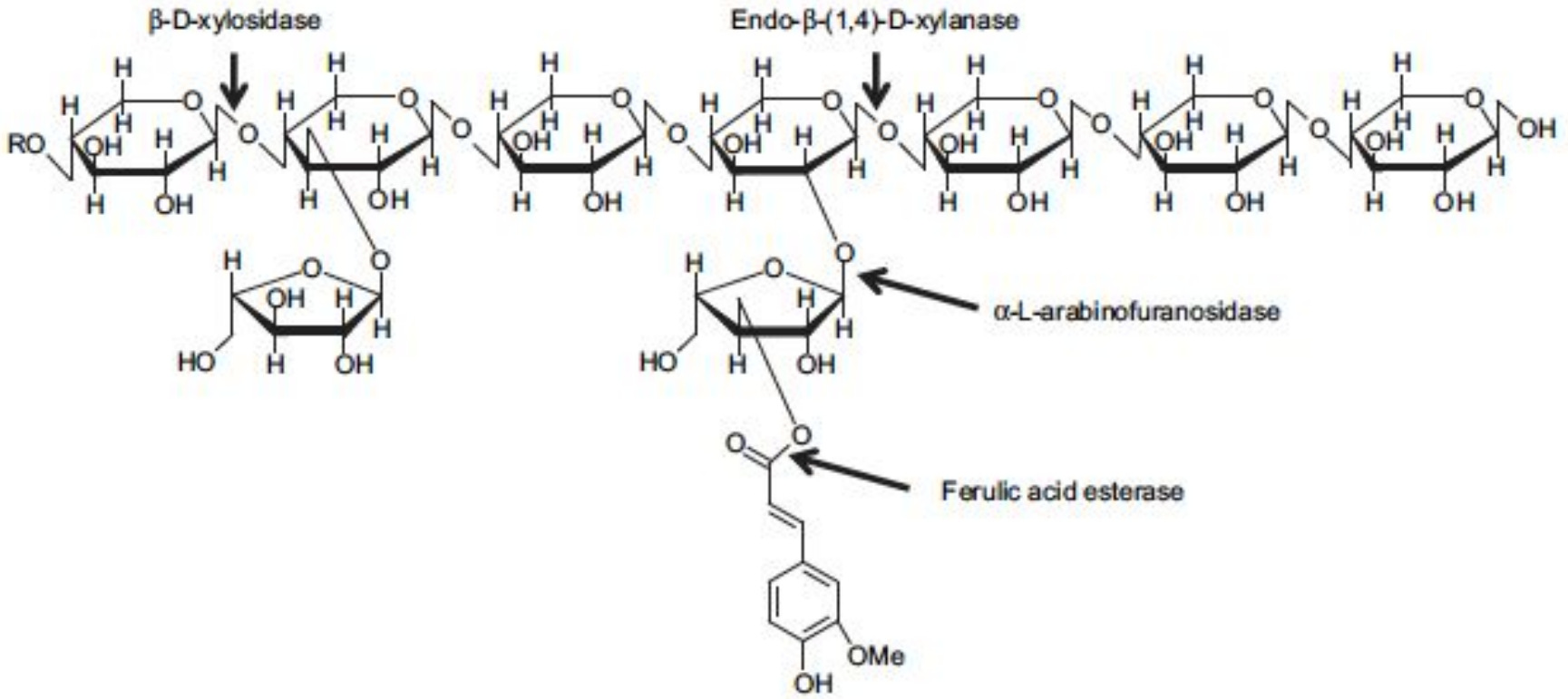
Coordinating Science and Value

Structured Effort



Impact of Enzymes on Quality

Arabinoxylan

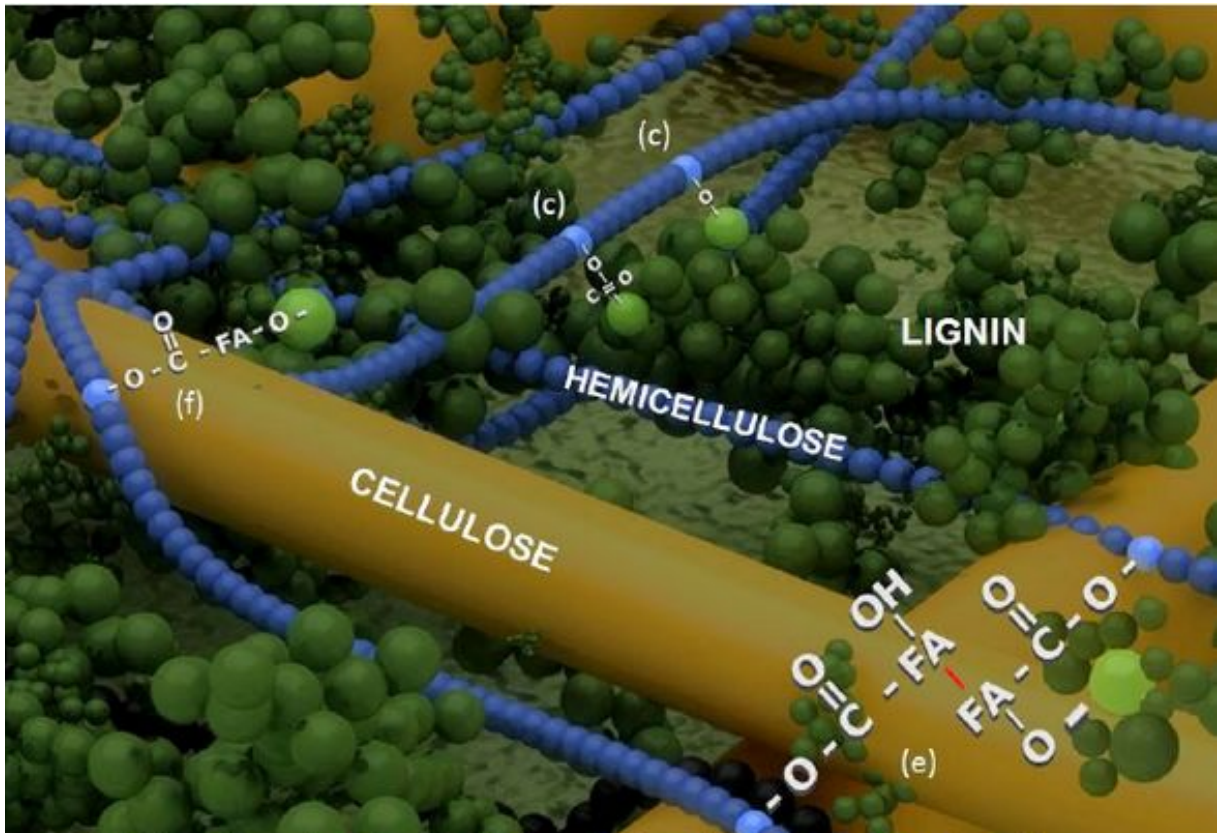


Kiszonas, A. et al. 2013

Fiber in Wheat

COALITION FOR GRAIN FIBER

- Fiber in wheat
  - Cell Wall
    - Cellulose
    - Arabinoxylan
    - Beta-glucan
    - Lignin
    - Glucomannan
  - Fructan (FODMAPS)
  - Resistant Starch



Santiago, R., et al. 2013

A Key Challenge to US and the World
Chronic Disease Kills Millions, Costs Billions

COALITION FOR GRAIN FIBER

Diabetes kills every 5 seconds.

Cardiovascular disease, every 2 seconds.

Cost of chronic disease in US:

$700 billion per year

50x the value of the annual US wheat crop, which is

- 20% of global and food consumption
- Largest source of US dietary fiber intake (>33%)