Food As Medicine, How Beans Make Us Healthier
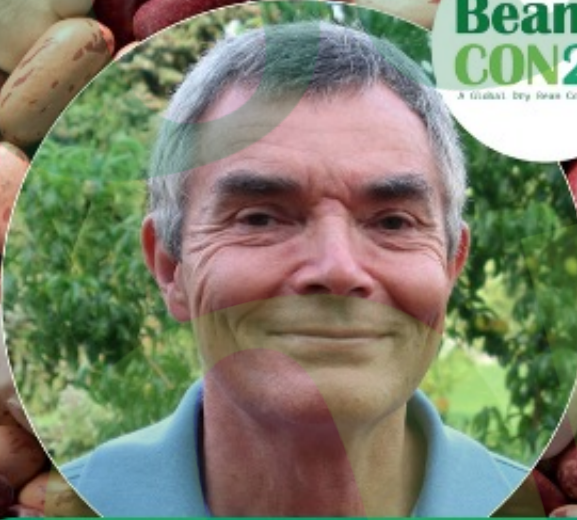
Bean CON24
A Global Dry Bean Conference

Dr. Chelsea Didinger
A Legume a Day

Dr. Henry Thompson
Colorado State

Nick Buettner
The Blue Zones

Dr. Raymond Glahn
USDA, Agricultural Research Service

The MANY Health Benefits of Beans

- Longevity
- Nutrition and iron bioavailability
- Benefits of beans for promoting gut health
- Preventing chronic diseases, like cancer

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Bean Nutrition

It's hard to beat beans.

Which has more dietary fiber?

Beans: 2-3 times more fiber than cereal grains!

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And how about potassium?

1 serving of beans has ~ the same amount of potassium as a banana

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WHO WE ARE

Blue Zones brings over 20 years of research, exploration, and solutions from the world's most extraordinary cultures—the blue zones—where people have lived better and longer than anyone else on the planet.

OUR PURPOSE

To empower everyone, everywhere to live better, longer.

OUR PROMISE

More good years.
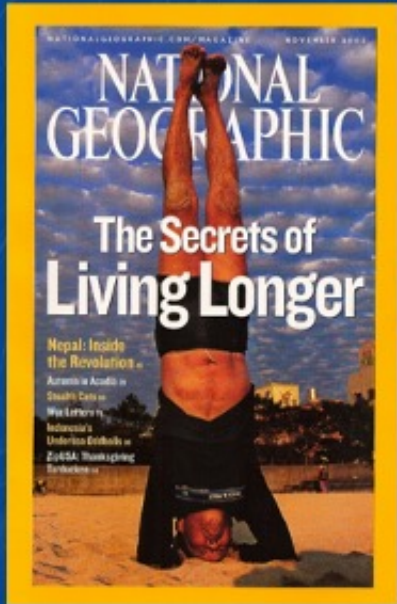
Partnered with and trusted by leading organizations:

NATIONAL GEOGRAPHIC · AARP · UNIVERSITY OF OXFORD · GALLUP

CDC · HEALTH UNIVERSITY OF MINNESOTA · NIH National Institutes of Health · BUSH'S BEST · BORGO EGNAZIA NOWHERE ELSE. · Unilever

Blue Zones Food Guidelines

95% PLANT-BASED

5% ANIMAL-BASED

65% CARBS

20% FATS

15% PROTEINS

MONTHLY

Retreat from meat: Blue zones centenarians eat about 2 oz or less about 5x per month

Reduce dairy

WEEKLY

Slash sugar: Consume only 28 grams (7 teaspoons) of added sugar daily

Eliminate eggs: No more than 3 per week

Go easy on fish: Fewer than 3 oz, up to 3 times weekly

DAILY

Snack on nuts: About 1-2 handful a day

Drink mostly water: About 7 glasses / day; coffee, tea, and wine in moderation

eat often with family and friends

Daily dose of beans: Half-cup to one cup / day

Go wholly whole: Single-ingredient, raw, cooked, ground, or fermented, and not highly processed

95-100% plant-based

Global Burden of Food-related Illnesses

Poor diet is the leading risk factor for deaths in the majority of countries around the world: Unhealthy diets are a larger determinant of disease and death than either tobacco or high blood pressure: What people are, and are not, eating.

2019 Global Burden of Disease Report

Top 10 Medical Conditions by Cost

Based on data from the CDC and presented in descending order, here are the top 10 most expensive chronic diseases for healthcare payers to treat.

1. Heart diseases and stroke
2. Diabetes
3. Arthritis
4. Alcohol-related health issues
5. Cancer
6. Obesity
7. Alzheimer's disease
8. Smoking-related health issues
9. Tooth Decay
10. Epilepsy

Items in **GREEN** = relevant to diet & nutrition

EAT Lancet Commission Report

Estimated healthcare costs due to preventable conditions

In absolute terms, the sheer cost of these preventable illnesses is estimated at **US$730.4 billion** in the USA alone

https://www.thelancet.com/journals/lanpub/article/PIIS2468-2667(20)30204-8/fulltext#back-bib1

Healthy Diets From
Sustainable Food Systems

**Food
Planet
Health**

E
A T

Diet Is The Leading Cause Of Chronic Disease

"The most important dietary risks in the United States are diets low in fruits, low in nuts and seeds, high in sodium, high in processed meats, low in vegetables, and high in trans fats"[1] - These risks are the leading cause of chronic disease, not other common culprits

Risk Factors As % Of Disability-Adjusted Life Years (DALYs)

86%

Health Spending: People with 1+ chronic disease

1The State of US Health, 1990-2010. Burden of Diseases, Injuries, and Risk Factors. JAMA. 2013; 310(6):591-606. doi:10.1001/jama.2013.13805; CDC FastStats on overweight and obesity, 2017; CDC National Diabetes Statistics Report, 2017; Zitongo Analysis

Estimating the impact of food choices on life expectancy: A modeling study

Based on Global Burden of Disease 2019 data

- Study compared an Optimal diet to a typical Western diet
  - More legumes, whole grains, and nuts
  - Less meat (red and processed)
  - Could increase life expectancy up to 13 years for men, and 10.7 years for women.

Neighborhood Psychiatry & Wellness

Psychiatry for the People

DIET

You Are What You Eat: Nutrition and Depression

New research links nutrition with mental health.

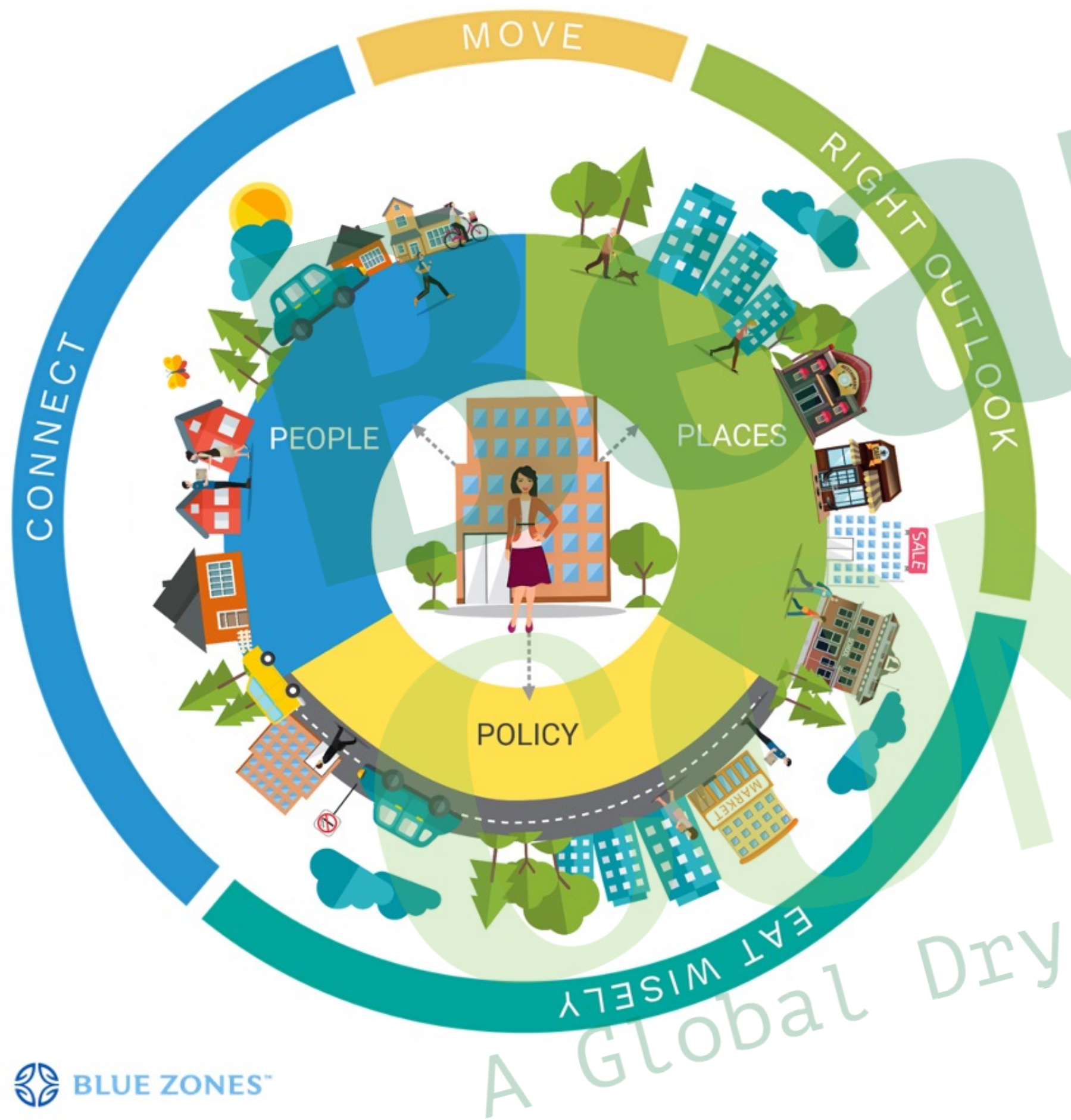Posted September 4, 2022 | ☑ Reviewed by Hara Estroff Marano

KEY POINTS

- How we eat is important not only for physical health but for emotional and mental well-being.

- Understanding how nutrition and depression play out for large groups of people is important for understanding best practices.

- Research identifies four classes of nutritional status correlated with depression.

- Optimizing nutrition may be helpful for preventing and alleviating symptoms of depression.

by Grant H. Brenner

In Pursuit of Health

Engagement
Recidivism
Inconsistency
Fractional

Unconscious
Habitual
Sustainable
Tipping Point

Temporary	Semi-Permanent	Permanent
Individual Will	Support From Family & Friends	Ubiquitous Nudges
Acute/Chronic Disease	At Risk	Healthy

Current & Legacy Models

Emerging Models

Care of the Patient

Health of the Public

Individual ... Expert ... ... People ... Places ... Policy

Case Management Disease ... Behavioral Risk Coaching

Mortality | Costs | Utilization | Morbidity | Disease | Lifestyle Risks | Financial Security | Purpose | Connectivity | View | Community | Access

Effect Data ... Digital Interface ... Causal Data

Next Generation Platform

Life Radius

Blue Zones Project works to improve what we call the Life Radius, the 20-mile area around a person's home where they spend 90% of their time.

Methods

POLICY
Public policies, systems design, built environment, and infrastructure improvements that cultivate social connections:
- Accessible and connected streets and sidewalks
- Vibrant spaces and town centers
- Green spaces
- Community gardens and Farmers Markets
- Public transportation

PLACES
Improving social connections with culture and programs in the places we spend the most time:
- Schools
- Worksites
- Restaurants
- Grocery Stores
- Faith and Civic Organizations

PEOPLE
Impacting those we spend most of our time with:
- Purpose Workshops
- Moais (Walking and Potluck)
- Neighborhood Groups and Associations
- Curated Volunteer Experiences
- Milestone Celebration Events (All Citizens)

MOVE

RIGHT OUTLOOK

CONNECT

PEOPLE

PLACES

POLICY

EAT WISELY

BLUE ZONES

Citizen-Led Committees

STEERING COMMITTEE

LEADERSHIP TEAM

POLICY COMMITTEES
Built Environment
Food Policy
Alcohol Policy

SCHOOL COMMITTEES
Walking School Bus, Safe Routes to School

WORKSITE COMMITTEE

RESTAURANT & GROCERY COMMITTEE

FAITH-BASED & CIVIC ORGANIZATION COMMITTEE

ENGAGEMENT COMMITTEE
Individual Pledges
Moais
Purpose
Volunteering

NCH HEALTHCARE SYSTEM
Case Study

Specific Actions Taken by the NCH to Achieve a Certified Blue Zones Worksite

- **Engage leadership** in well-being training.

- Host an **all-company kick-off meeting** to introduce Blue Zones Projects.

- Provide Blue Zones Project **prompts and messaging on campuses.**

- **Offer purpose workshops** and tie to volunteer opportunities.

- **Work with Sodexo** to nudge healthier food choices.

- Schedule **regular produce markets** on campuses.

- Create **walking paths.**

- Launch **Moais.**

- **Provide education** to enhance ergonomic environment.

- **Review & upgrade policies** and services to employees that emphasize health and well-being.

Optimize Physical Environment

ACTIONS TO IMPROVE FOOD ENVIRONMENT

Removed sugar-sweetened drinks from cafeterias & vending	
Added BZ Inspired menu items	
Added grab 'n' go plant-based choices	
Product placement intended to nudge	
Replaced deep fryers with air fryers	
Produce Markets & Organic Garden	

RESULTED IN

- Approximately 500 pounds of sugar **not** sold/consumed monthly
- **220% increase** in water sales
- **39% increase** in plant-based meals sales
- **72% increase** in vegetables sales
- **34% decrease** in sales of fried foods
- **25% positive change** in nutrition score

BLUE ZONES® | Adventist Health

Healthy Food Offerings

NCH BLUE ZONE APPROVED RESTAURANT CAFÉ CHANGES

- **Removal of Deep Fat Fryers** Deep fryers were replaced with air fryers in May 2018

- **Single Beverage Vendor Contract** NCH moved away from single beverage vendor contract to allow more options for water and remove sodas with artificial sweeteners

- **Blue Zone Patient Menu Enhanced** Sodexo launched Blue Zone Approved patient menu in August 2018

- **Healthy Sodexo** sales within the cafeterias continue to rise

Increase in Sales	NCH Wave Café	NCH Tree Top Cafe
Water	219%	221%
BZ Value Meal	53%	25%
Veggie Sales	63%	65%
Veggie Burger	158%	92%

BLUE ZONES® | Adventist Health

Optimize & Engage Social Connections

ACTIONs

Created walking & potluck Moais

Increased volunteer opportunities

Added social events outside of work

Started a *Leadership Listens* forum

RESULTED IN

Approximately **53% joined Moais**
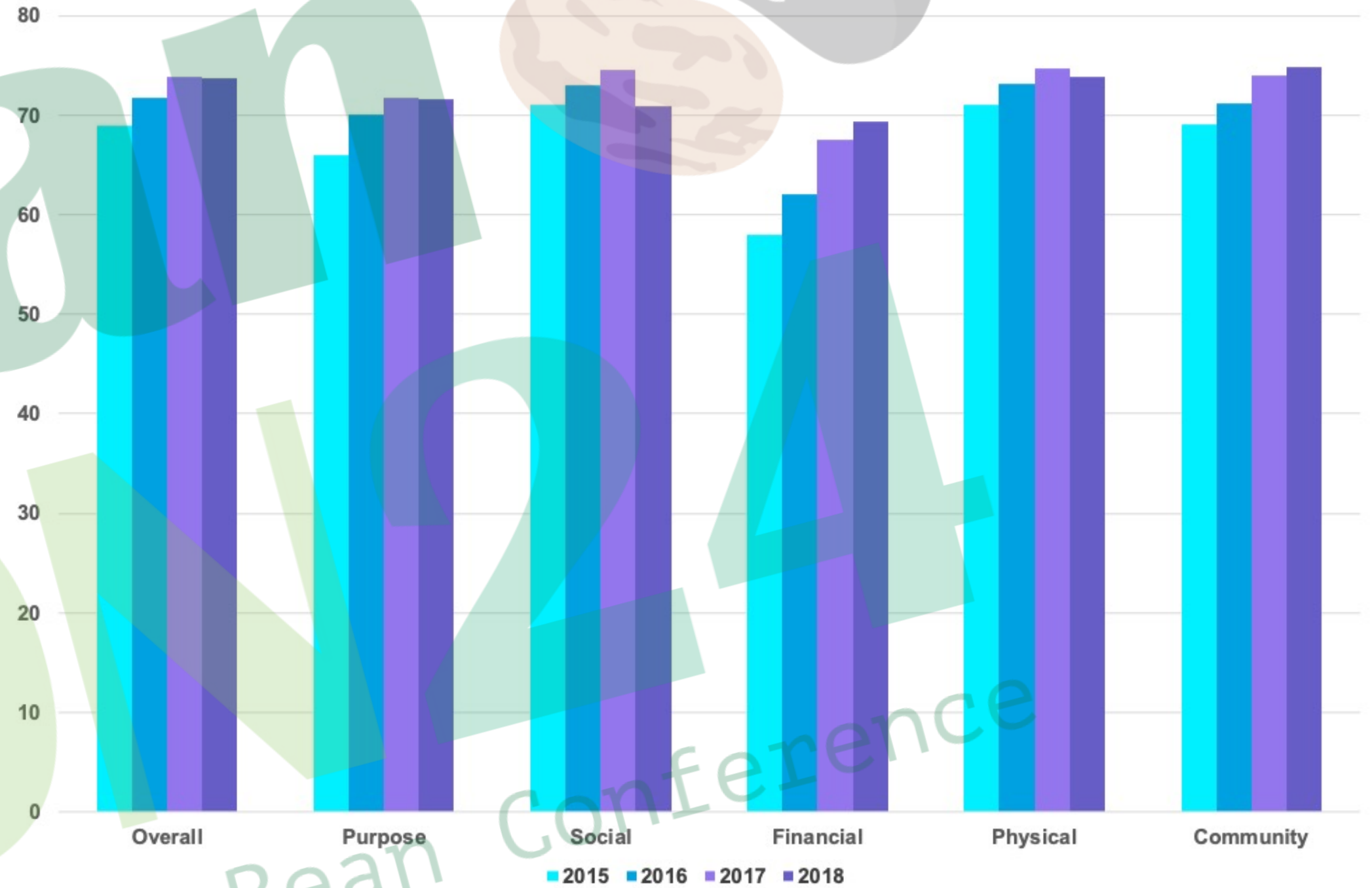
4.8% NCH social **well-being score**

7.1% increase in number of employees who have **someone who encourages them to be healthy**

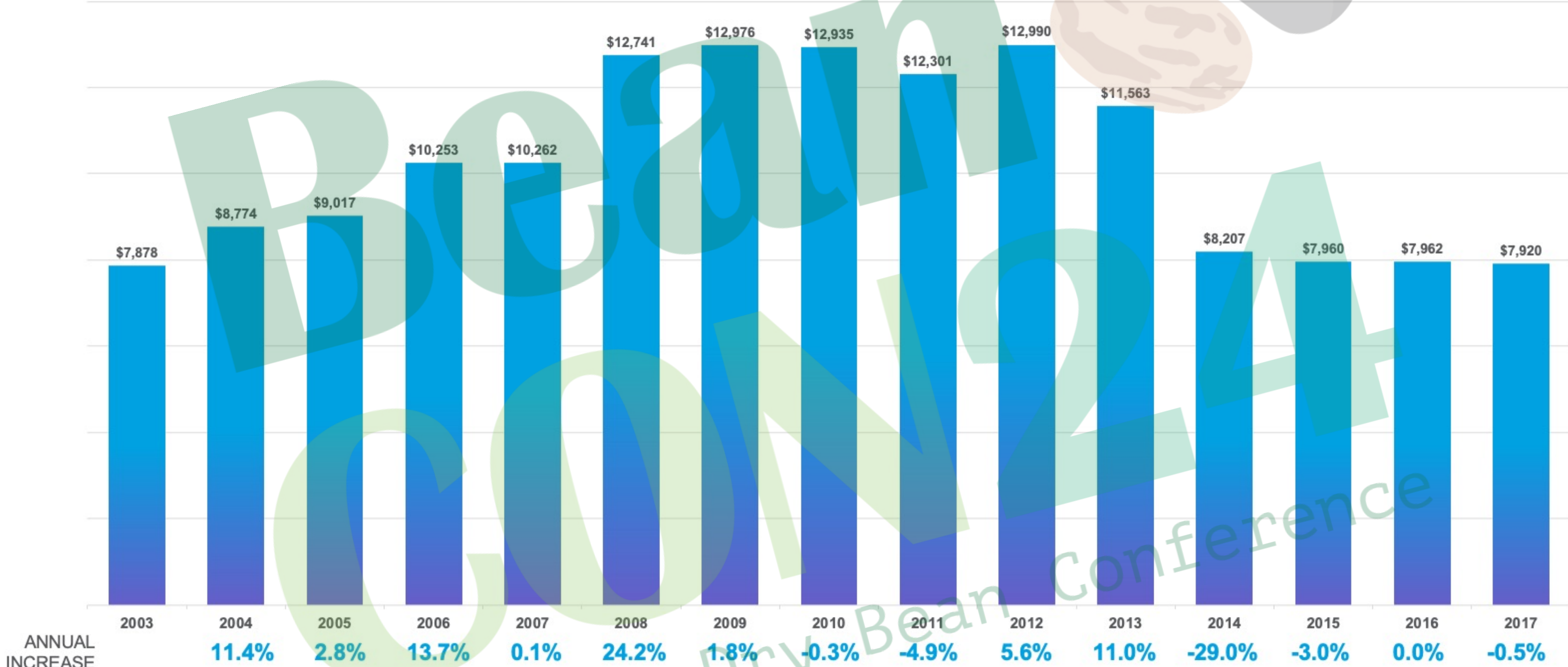**More than 4200** employee volunteer hours logged

BLUE ZONES®   Adventist Health

Positive Changes in Every Area of Well-Being

Scores improved in nearly every category with overall well-being jumping **nearly five points from 68.9 to 73.8** on a scale of 0 to 100.

Watson Wyatt: Y-O-Y Changes in Claims Expenses

NCH Claims PEPY

Year	Value	Annual Increase
2003	$7,878	
2004	$8,774	11.4%
2005	$9,017	2.8%
2006	$10,253	13.7%
2007	$10,262	0.1%
2008	$12,741	24.2%
2009	$12,976	1.8%
2010	$12,935	-0.3%
2011	$12,301	-4.9%
2012	$12,990	5.6%
2013	$11,563	11.0%
2014	$8,207	-29.0%
2015	$7,960	-3.0%
2016	$7,962	0.0%
2017	$7,920	-0.5%

BLUE ZONES®   Adventist Health

Positive Changes to the Bottom Line

54%

decrease in healthcare expenditures, resulting in $27 million in savings over a six-year period

0%

increase in employee health insurance premiums during a four-year period

40%

drop in number of work days lost related to any/ all types of injuries from fiscal year 2015 to 2016

(381 days to 226 days)

BLUE ZONES® | Adventist Health

Organizations are moving in this direction

Special Report

61 Nutritional Update for Physicians: Plant-Based Diets. Philip J Tuso, MD; Mohamed H Ismail, MD; Benjamin P Ha, MD; Carole Bartolotto, MA, RD

CME

Physicians are becoming more involved in helping their patients adopt healthier lifestyles. Healthy eating may be best achieved with a plant-based diet (which encourages whole, plant-based foods and discourages meats, dairy products, and eggs as well as all refined and processed foods). Research shows that these diets are cost-effective, low-risk interventions that may lower body mass index, blood pressure, HbA_{1c}, and cholesterol levels, and may also reduce the number of medications needed to treat chronic diseases.

Food as Medicine

Inside the Fauci Wuhan Controversy

Newsweek

YOUR MEAL SHOULD COME WITH A WARNING LABEL. HERE'S WHY.

If a poor diet **caused** the problem…(+/-)

A healthy diet can **correct** the problem

- Goes **beyond healthy eating** for preventing disease and promoting general wellness.
- It is food used along with (or in some cases without medicines or surgery) as a **prescribed intervention**, for the treatment and cure of many diseases, thereby placing it within an accepted standard of care.

Food Matters

"*People are fed by the food industry, which pays no attention to health, and are treated by the health industry, which pays no attention to food.*"

— Wendell Berry

Repair and Renewal

"*Health is not luck. We have an innate ability to maintain good health if we establish the optimal environment for healing.*"

Joel Fuhrman, MD

Measurable Results

> 5% Sustained Improvement in Well-Being

$40M
Follow-On Grants

- 2.5 years added to life spans within one year of participating in the Blue Zones Project.
- **48% increase in tourism** since 2012.
- **Jump to 34th place** in Minnesota County Health Rankings (previously 68 out of 87 counties)

+12%
Life Evaluation

- Beach K-8 schools.
- **15% drop in overweight/obese** adults.
- **10% increase** in exercise.
- **17% drop** in smoking.
- **12% rise** in Life Evaluation.
- **$72M in medical cost and lost productivity savings.**

$20B
Lifetime Reduced Smoking Value

- Sixteen point increase in residents who exercise at least 30 minutes three or more days of the week, now at 62%.
- **90,000 residents and 280 organizations engaged.**

$27M
Medical Claims Redux

- 54% decrease in healthcare expenditures over six years.
- **$27 million reduction in self-insured medical claims.**
- **Nearly 60%** of all employees pledged participation.
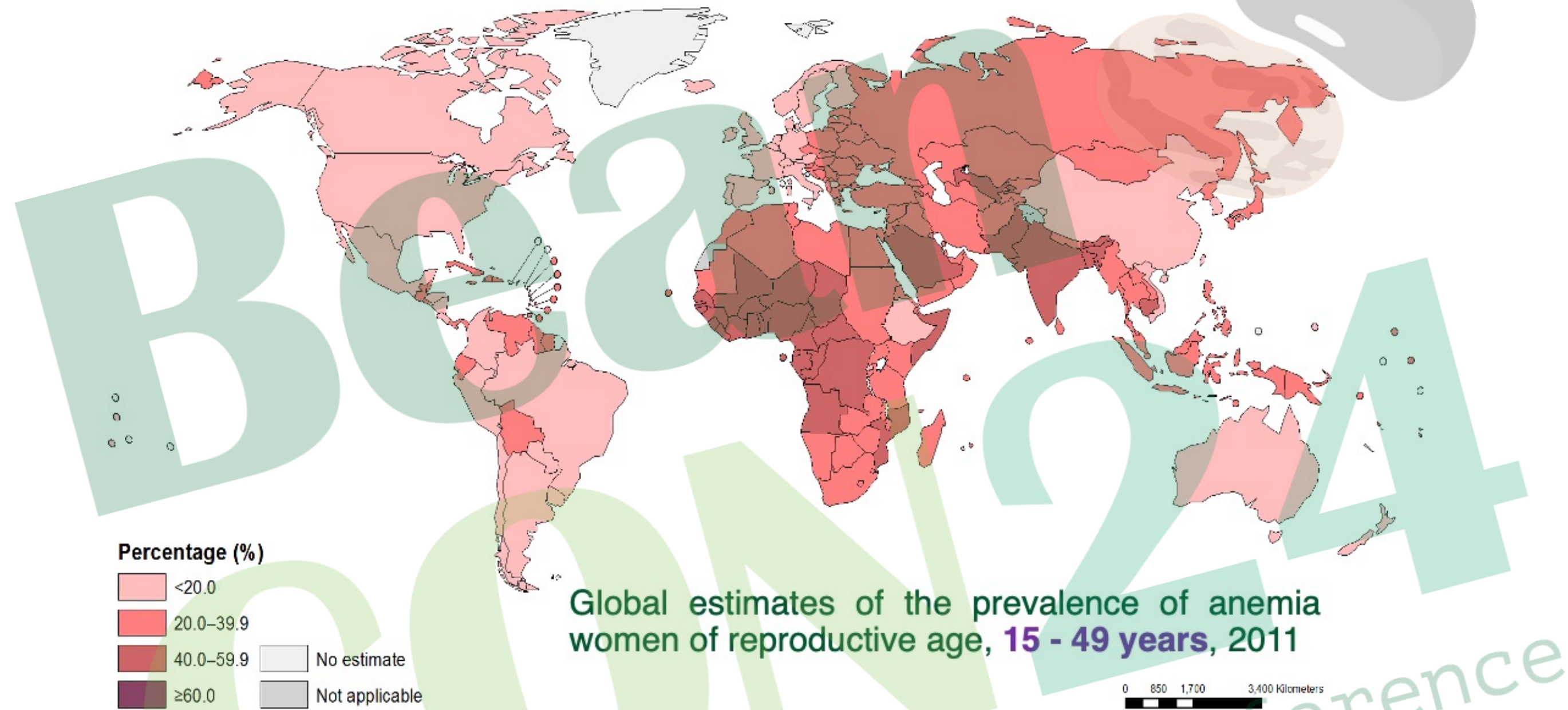- **40% decline** in lost work days due to injury.

Why are we talking about beans and iron nutrition?

Percentage (%)

<20.0

20.0–39.9

40.0–59.9   No estimate

≥60.0   Not applicable

Global estimates of the prevalence of anemia women of reproductive age, 15 - 49 years, 2011

0   850   1,700   3,400 Kilometers

WHO. The global anemia prevalence in 2011. Geneva: World Health Organization; 2015.

Beans are an integral component of many food systems; thus, an excellent vehicle for delivery of bioavailable Fe to combat anemia

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To understand the nutritional quality of Fe in foods, one must be able to measure food Fe bioavailability

Tools for Fe Bioavailability:

The **Caco-2 cell bioassay** is the established tool for predicting food Fe bioavailability. High throughput, low cost.

The **poultry model (modern broiler chicken)** is an established animal for human Fe nutrition, with significant advantages over other animal models.
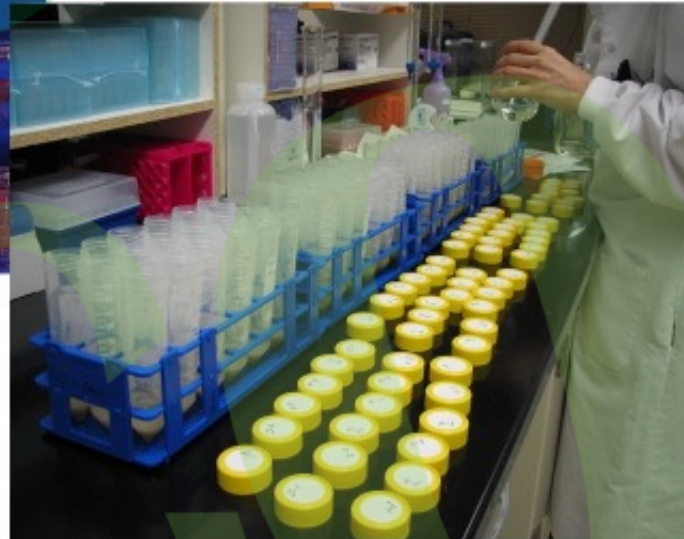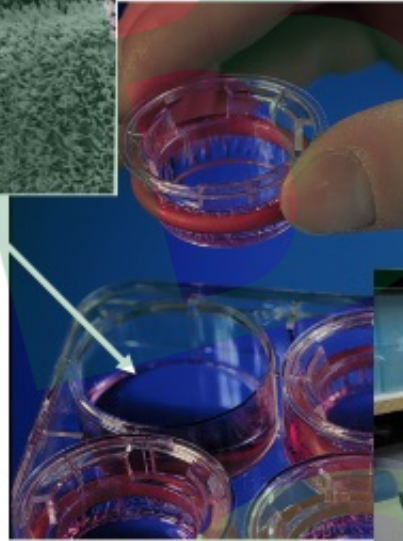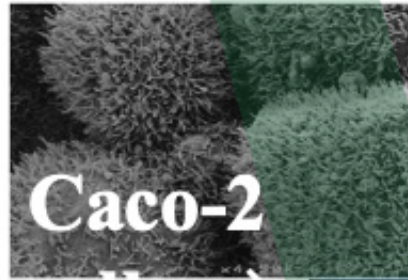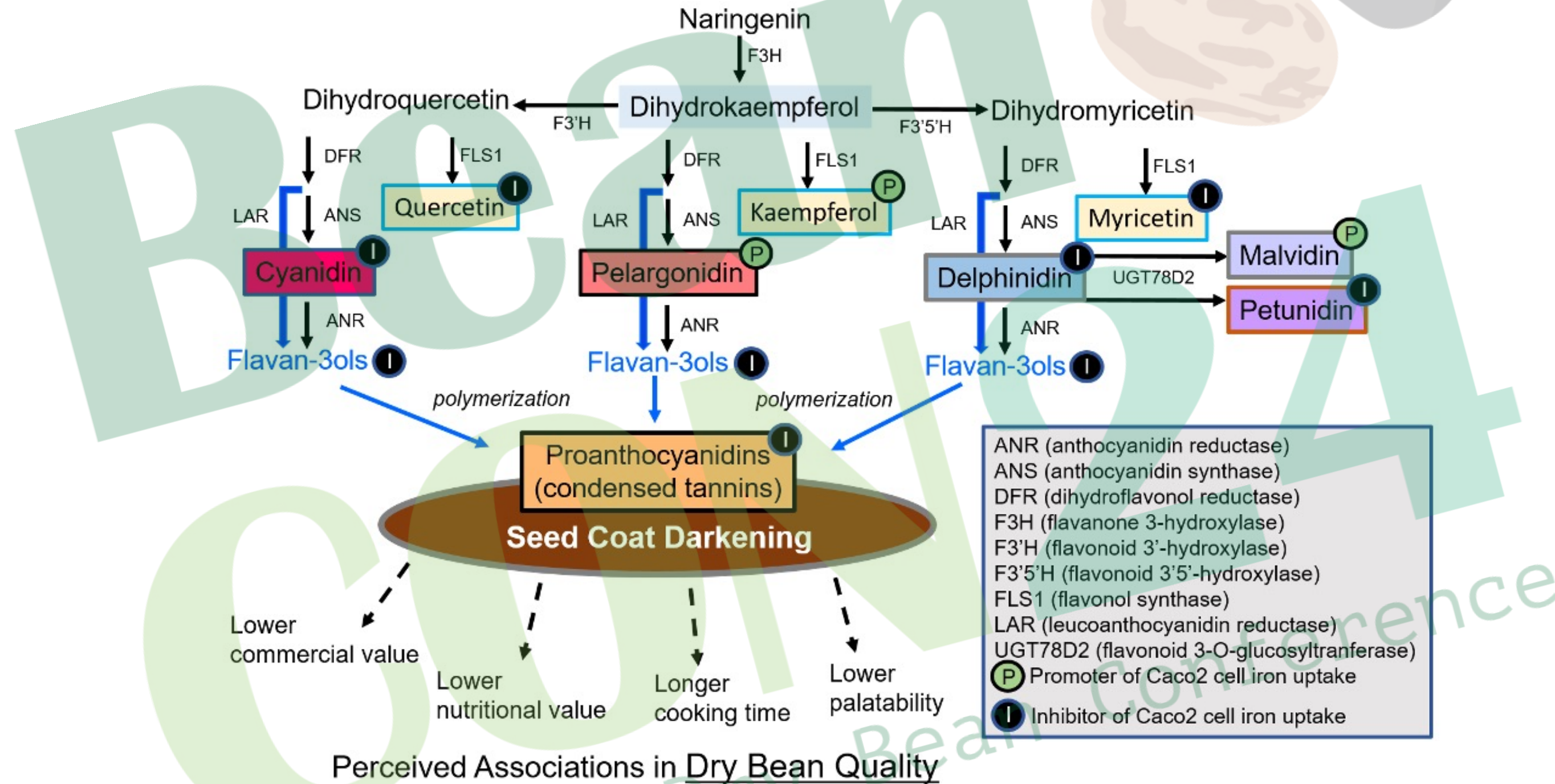

These models can also be used to determine mechanisms of Fe bioavailability. These models can be used to evaluate diets and meal plans. Highly cost-effective!

The Bean Seed Coat is the primary factor controlling Fe nutrition from beans.

Flavonoid Pathway (simplified) for Seed Coat Color & Darkening

ANR (anthocyanidin reductase)
ANS (anthocyanidin synthase)
DFR (dihydroflavonol reductase)
F3H (flavanone 3-hydroxylase)
F3'H (flavonoid 3'-hydroxylase)
F3'5'H (flavonoid 3'5'-hydroxylase)
FLS1 (flavonol synthase)
LAR (leucoanthocyanidin reductase)
UGT78D2 (flavonoid 3-O-glucosyltranferase)
(P) Promoter of Caco2 cell iron uptake

(I) Inhibitor of Caco2 cell iron uptake

Iron Bioavailability and Flavonoid Profiles of Domestic Dry Bean Varieties

Inhibitory (I) compounds are very potent!
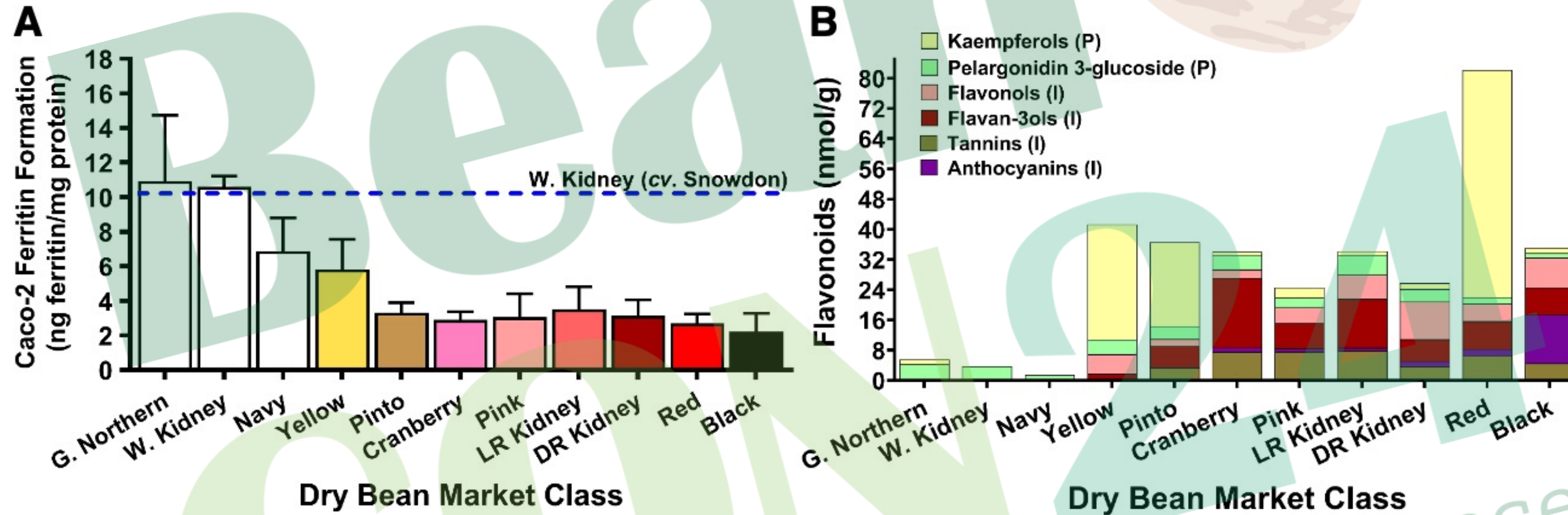
Iron bioavailability (**A**) and flavonoid compositions (**B**) of 50 dry bean varieties in the **Historic Bean Collection produced in Hatton, North Dakota**. Each market class is represented by 3 – 6 different varieties, each measured in triplicate. Hyphenated lines indicate the average iron bioavailability of a white kidney bean reference control run with each Caco2 bioassay.

# The Best Opportunity for Enhanced Fe Nutrition From Beans….Manteca Yellow Beans

- Studies indicate that specific varieties within the yellow bean market class represent the best opportunity to date to provide more bioavailable Fe.

- They have been doing so for a very long time, but simply have not been identified until recently.
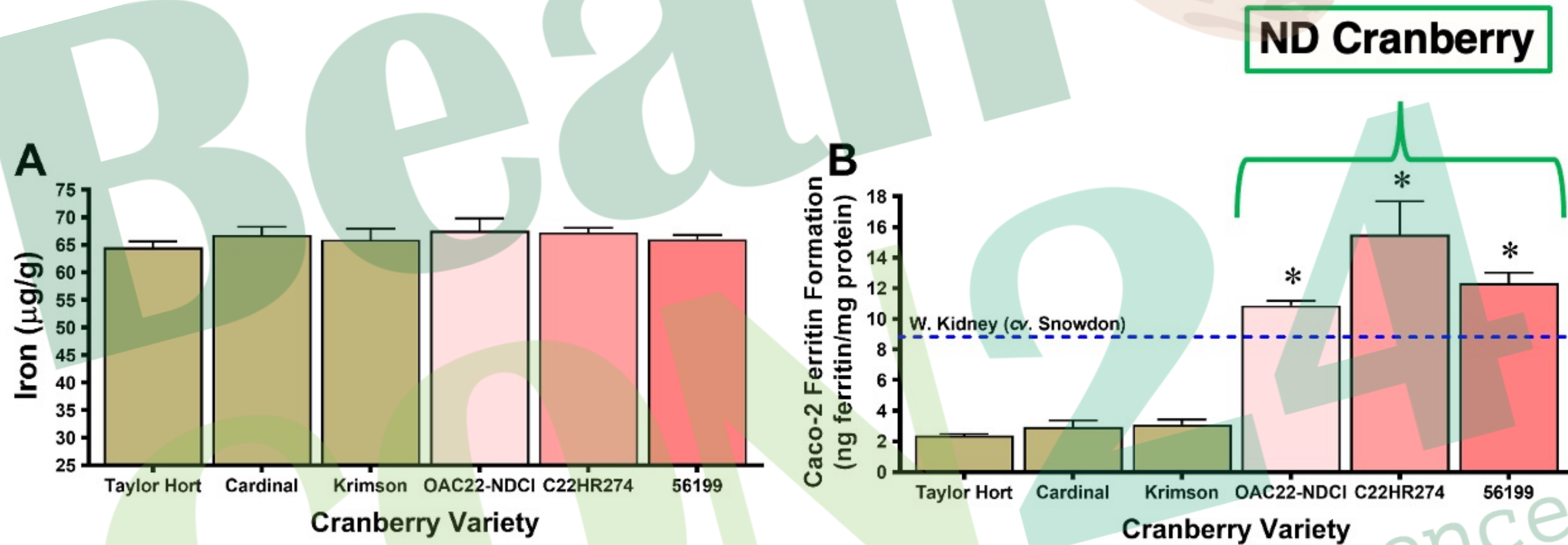
Iron Bioavailability Profiles of Dry Bean Market Classes
Specific white, yellow and pinto varieties = enhanced Fe nutrition!
Non-darkening (ND) and Slow-darkening (SD) genes
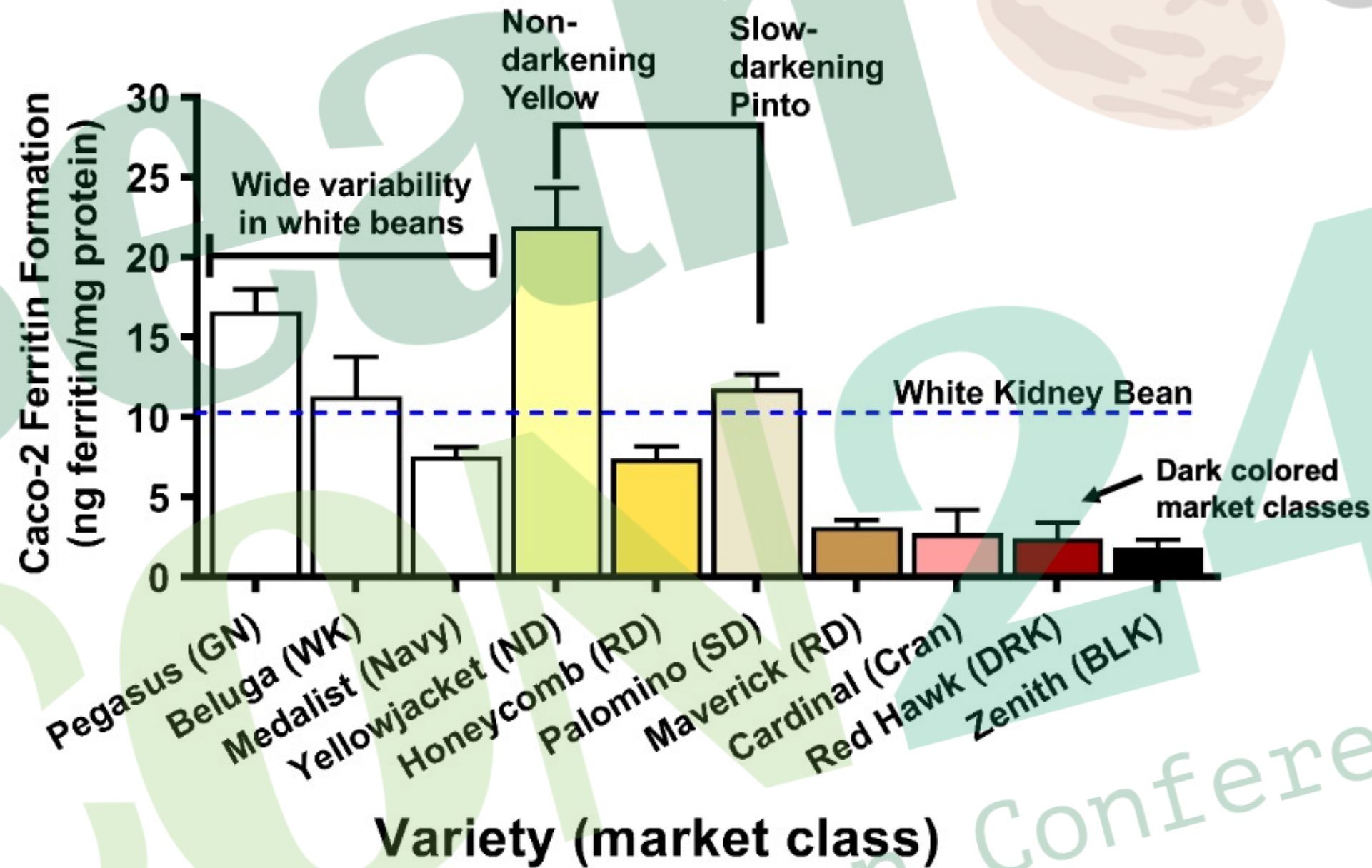
Iron bioavailability of pre-soaked beans after cooking. Values are means ± standard deviations of three technical replicates from each variety. Iron bioavailability is measured as Caco-2 cell ferritin formation (ng ferritin / mg total cell protein) after exposure to an *in vitro* digestion of cooked, drained, lyophilized and milled beans (dry weight). GN, great northern; WK, white kidney; ND, non-darkening; SD, slow-darkening; Cran, cranberry; DRK, dark red kidney; BLK, black bean.

Non-Darkening Cranberry Beans have **MORE** Bioavailable Iron: Collaboration with Dr. Peter Pauls, Univ. of Guelph

ND Cranberry

A

Iron (µg/g)

Cranberry Variety: Taylor Hort, Cardinal, Krimson, OAC22-NDCI, C22HR274, 56199

B

Caco-2 Ferritin Formation (ng ferritin/mg protein)

W. Kidney (*cv.* Snowdon)

Cranberry Variety: Taylor Hort, Cardinal, Krimson, OAC22-NDCI, C22HR274, 56199

Iron concentrations (**A**) and iron bioavailability (**B**) of regular darkening (RD) and slow darkening (ND) cranberry beans produced in North America. Values are the means (SD) of three replicate samples each measured in triplicate (n = 6). **Wiesinger, Pauls et al. (2023)** in preparation

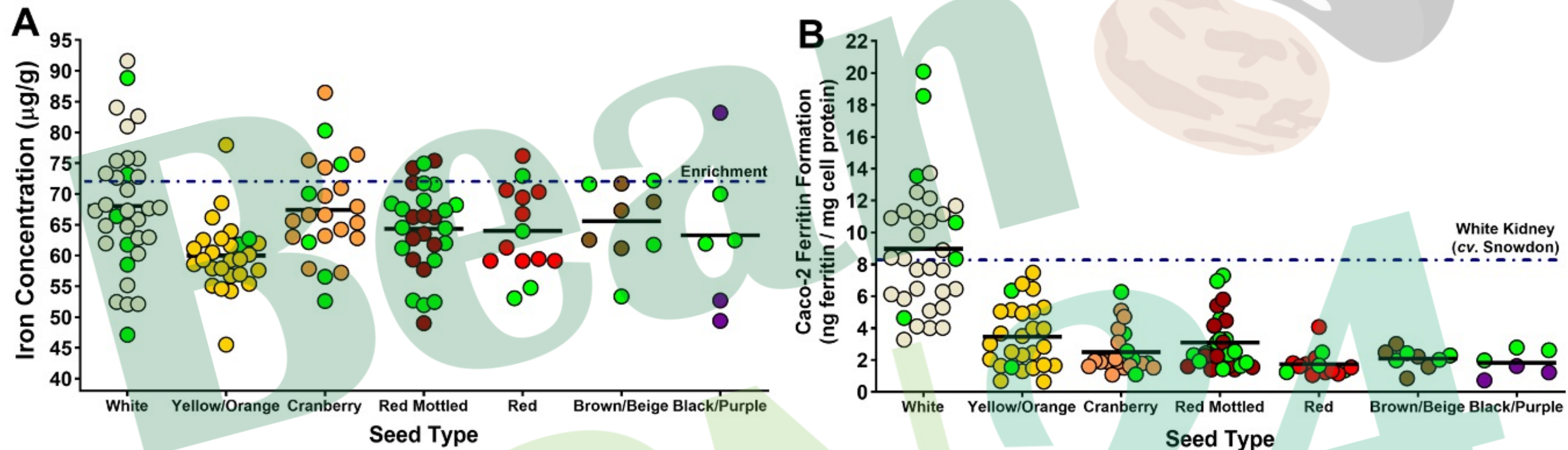# Evaluating Fe Nutrition in Bean Breeding Programs
CIAT – Uganda 2022

Figure 1: Dot plots depicting iron concentrations (A) and iron bioavailability (B) of 140 "biofortified" and parent lines of dry bean entries from seven market classes produced in Uganda. Each dot represents the mean value of two technical replicates. Iron concentrations are measured as micrograms per gram of cooked, lyophilized and milled whole beans (dry weight). Iron bioavailability is measured as Caco-2 cell ferritin formation after exposure to an in vitro digestion of cooked, lyophilized and milled whole beans. Hyphenated line indicates the minimum target value for the enrichment of iron in dry beans (A) and the ferritin response from a commercially produced white kidney bean (cv. Snowdon) used as a reference standard in each Caco-2 bioassay (B). Biofortified varieties are highlighted in green.

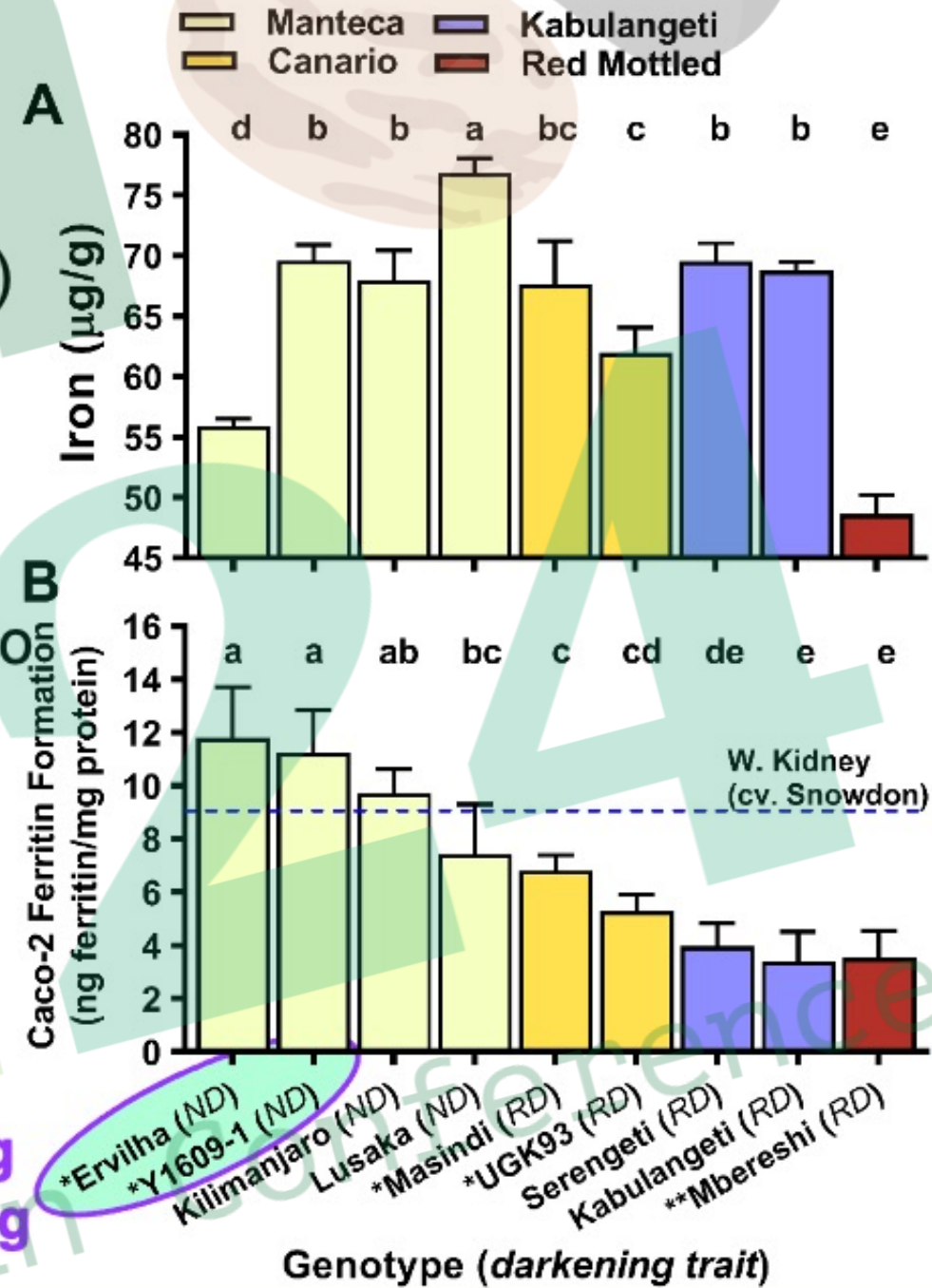# Farmer Participatory Selection (FPS) in Zambia (2020 – 2021)

- Malashi Research Station – Mpika, Zambia
- <u>40 farmers</u> (20 males & 20 females)
- Selection based on **seed color**, **seed size**, **productivity**
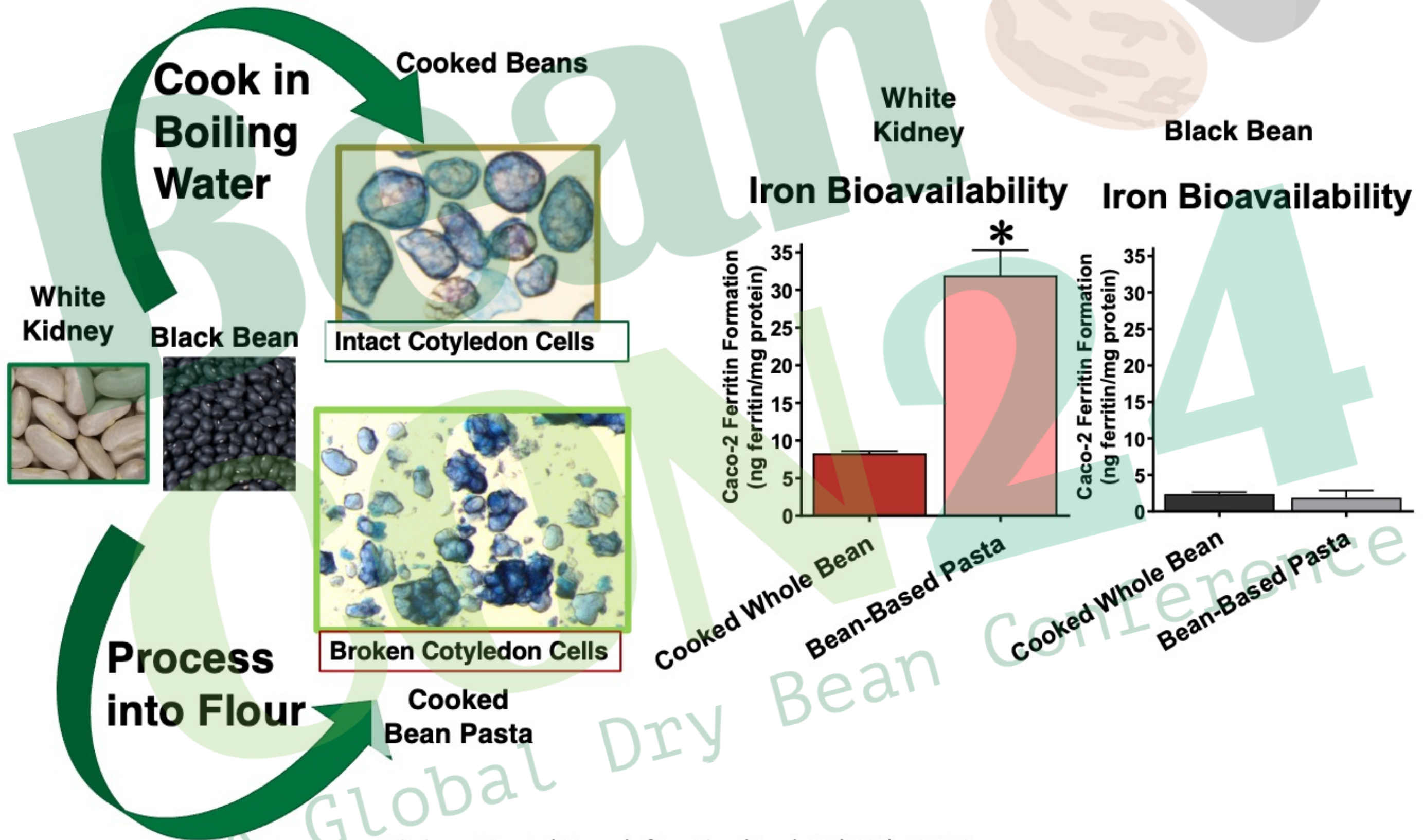- Discussions, **cooking** & rankings to select <u>top genotypes</u>

**Fast Cooking
ND Darkening**

Ervilha **YBC 129** Y 1609-1

Misindi **YBC 120** UGK93 **YBC 264**

Market display in Lusaka, Zambia

FPVS field, discussion and cooking trials in Zambia. Photos by Kelvin Kamfwa, University of Zambia (2021)

A

Legend: Manteca, Canario, Kabulangeti, Red Mottled

Iron (µg/g) chart, y-axis 45–80
Significance letters: d b b a bc c b b e

B

Caco-2 Ferritin Formation (ng ferritin/mg protein), y-axis 0–16
Significance letters: a a ab bc c cd de e e

W. Kidney (cv. Snowdon)

Genotype (*darkening trait*):
*Ervilha (ND) *Y1609-1 (ND) Kilimanjaro (ND) Lusaka (ND) *Masindi (RD) *UGK93 (RD) Serengeti (RD) Kabulangeti (RD) **Mbereshi (RD)

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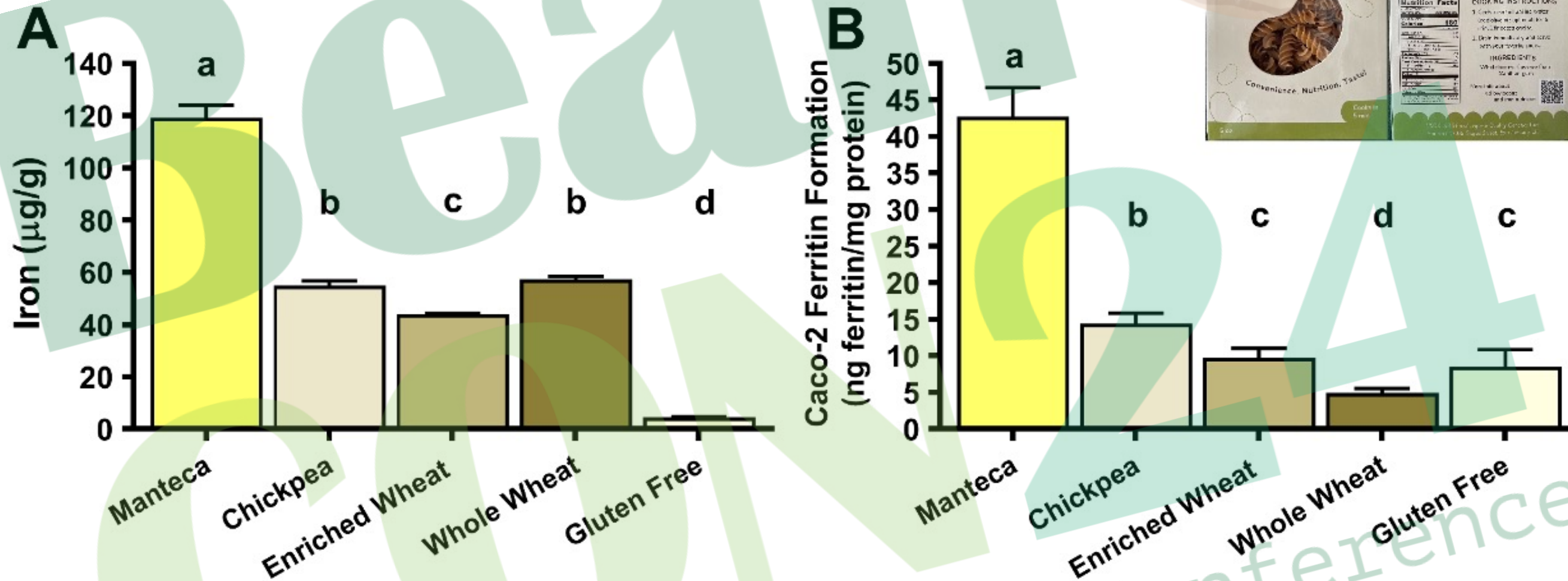A Global Dry Bean Conference

Processing Method and Seed Color Impacts Bean Iron Bioavailability

Wiesinger, J.A., et al. Journal of Functional Foods 71 (2020): 104018.

USDA Yellow Bean Pasta Delivers MORE Bioavailable Iron
Collaboration with Karen Cichy (ARS, East Lansing, MI)

Iron concentrations (A) and iron bioavailability (B) of Manteca yellow bean rotini pasta compared to commercially available chickpea, wheat and gluten free rotini pasta. Values are means ± standard deviations of six replicates from each pasta sample. Means sharing the same superscript are not significantly different at P ≤ 0.05.

Thank you!

Acknowledgements:
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Phil McClean (NDSU)
Phil Miklas (USDA)
Clare Mukankusi (CIAT)
Mercy Lung'aho (IITA)
Sharon Hooper (MSU)
Kelvin Kamfwa (UNZA, Zambia)
Peter Pauls (Univ. Guelph)

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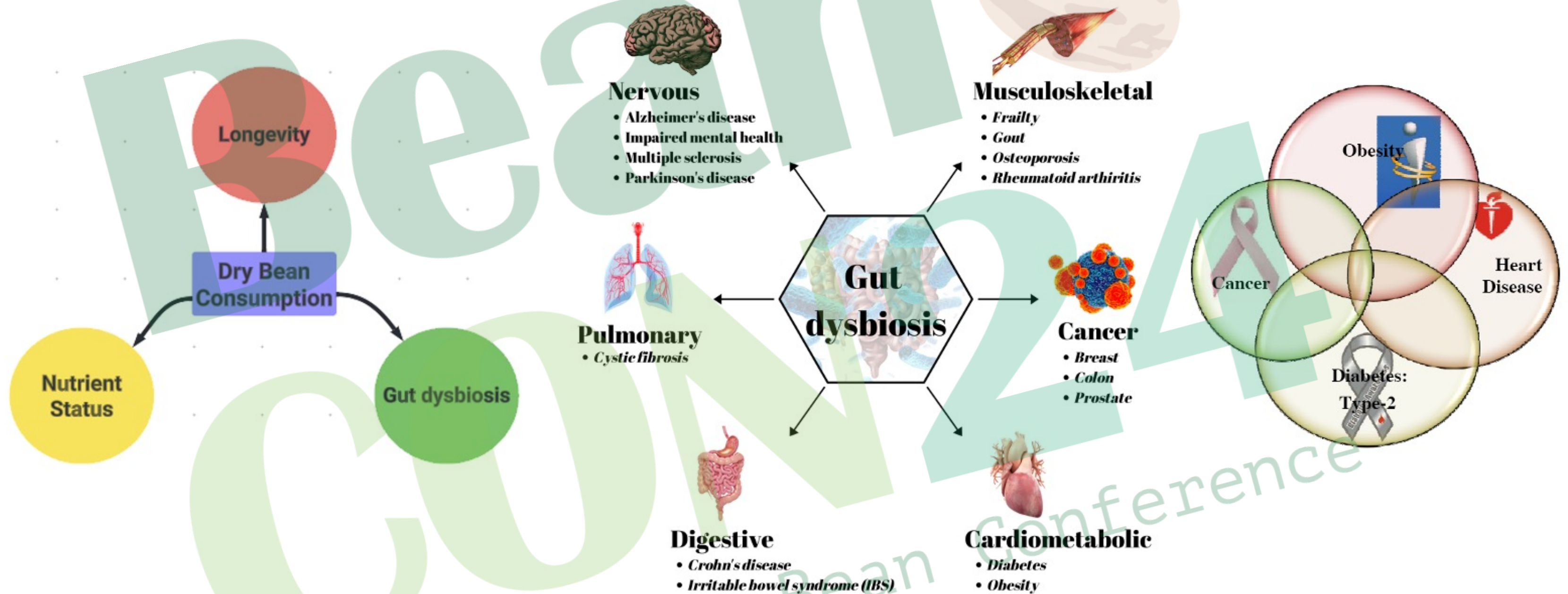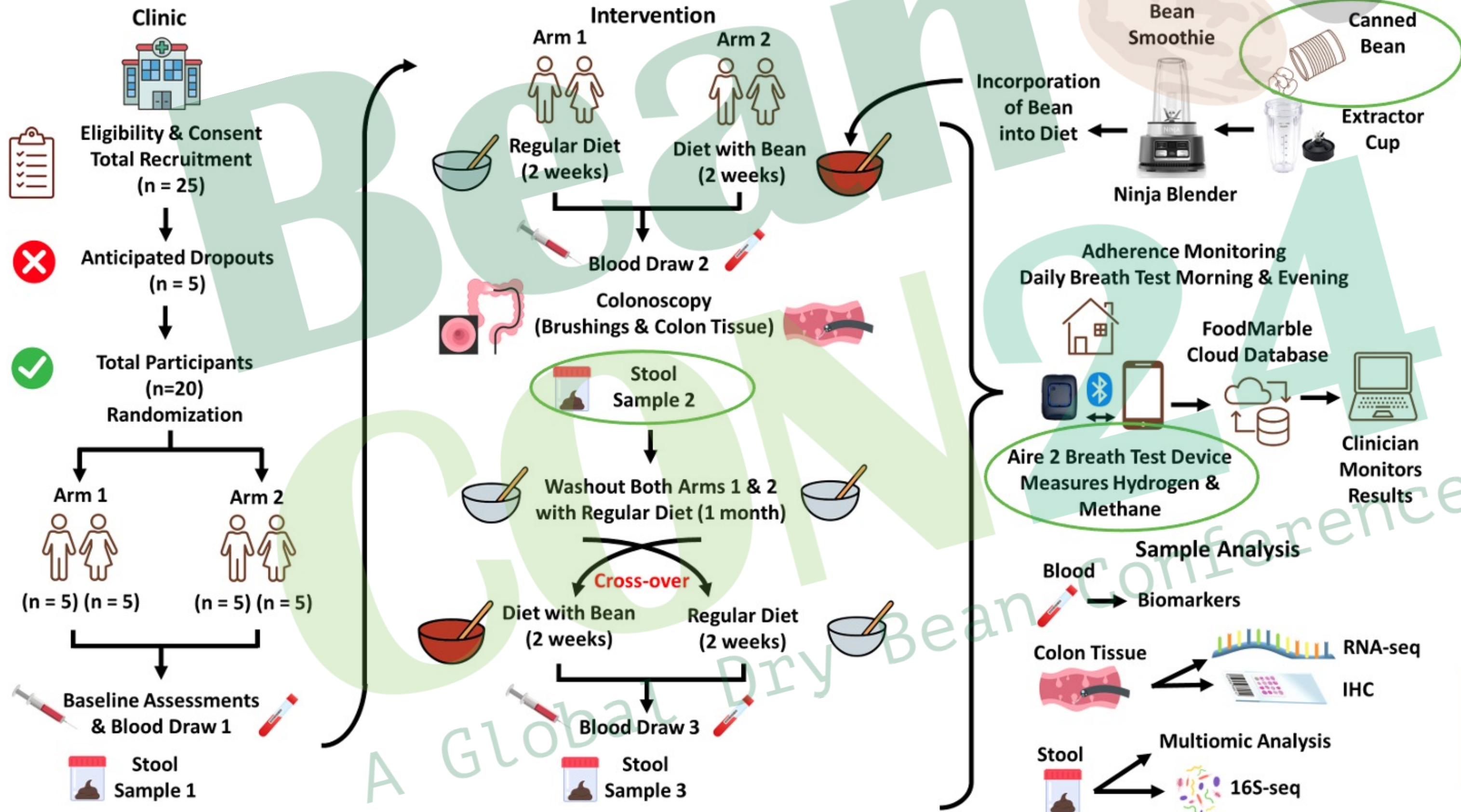A Global Dry Bean Conference

Beans is How

It's in your hands!

Good as it gets? Heck No. But it's a start. Preclinical-Clinical Insights

Launch of a Clinical Trial
More Insights

Bush's Best Cannellini Beans

Nutrition Facts

About 3.5 servings per container

Serving Size 1/2 cup (130g)

Amount Per Serving	
Calories	**110**

	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 120mg	5%
Total Carbohydrates 21g	8%
Dietary Fiber 9g	31%
Total Sugars <1g	
Includes 0g Added Sugars	0%
Protein 8g	13%
Vitamin D 0mcg	0%
Calcium 90mg	6%
Iron 2.8mg	15%
Potassium 490mg	10%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Sodium = 120 mg per serving

Servings per can = 3.5

Total Sodium per can = 420 mg

Approved clinical protocol

- **Reduced sodium**
- **1.5 cups cooked bean(1 can):**
  - **>30% Daily protein requirement**
  - **27g Dietary fiber: essentially meets daily recommendation**
  - **~90% of Americans fail to consume the recommended level of dietary fiber**

Beans should be everywhere

Yes, We Can!

Dry Bean and Other Pulses

The **Premiere**, **Authentic**, Low Fat, High Fiber, High Protein **ANTI-OBESOGENIC** Foods: Non GMO, Gluten Free, No cholesterol

The Secret of the "Ancients" Rediscovered

Culinary flexibility: whole food, whole powder, ingredient, any flavor/cuisine, texture, crunch

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