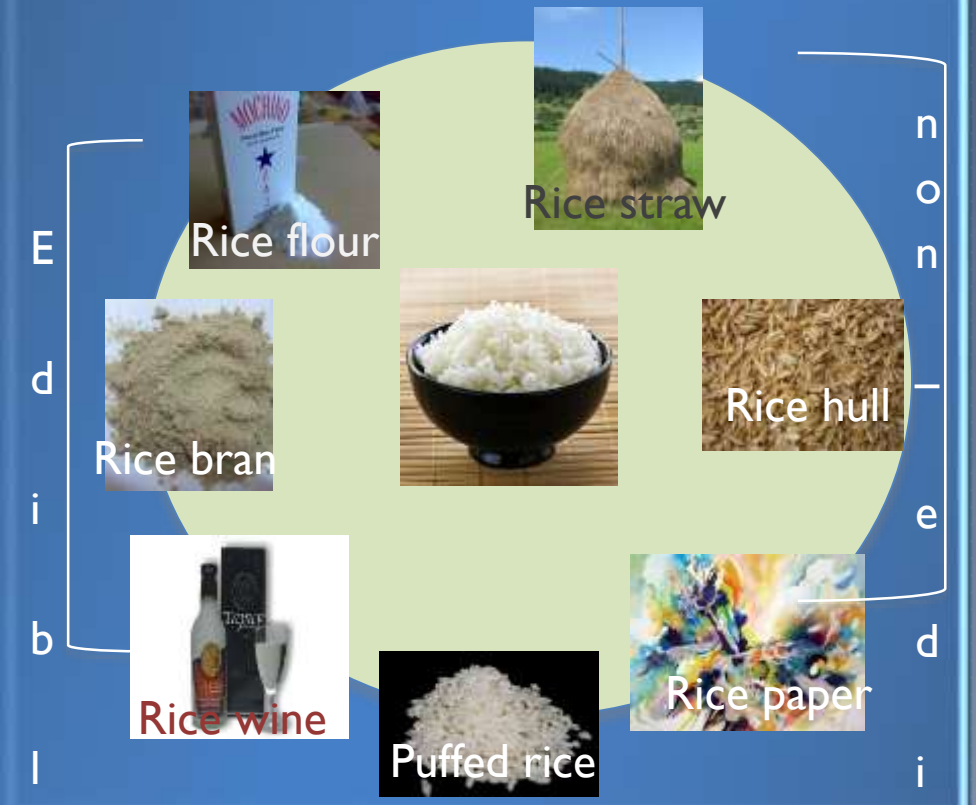
ACHIEVING RICE BIOPHARMA READINESS IN THE PHILIPPINES: CHALLENGES AND OPPORTUNITIES IN BIOTECH RESEARCH FOR DEVELOPMENT

Amor A. San Juan, MSc., Ph.D

email: amor.san_juan@upd.edu.ph

RICE GRAIN: FROM STAPLE STARCH INTO BIOPHARMACEUTICAL USE

- Traditionally: staple food source



- Revolutionary: transgenic rice into drug

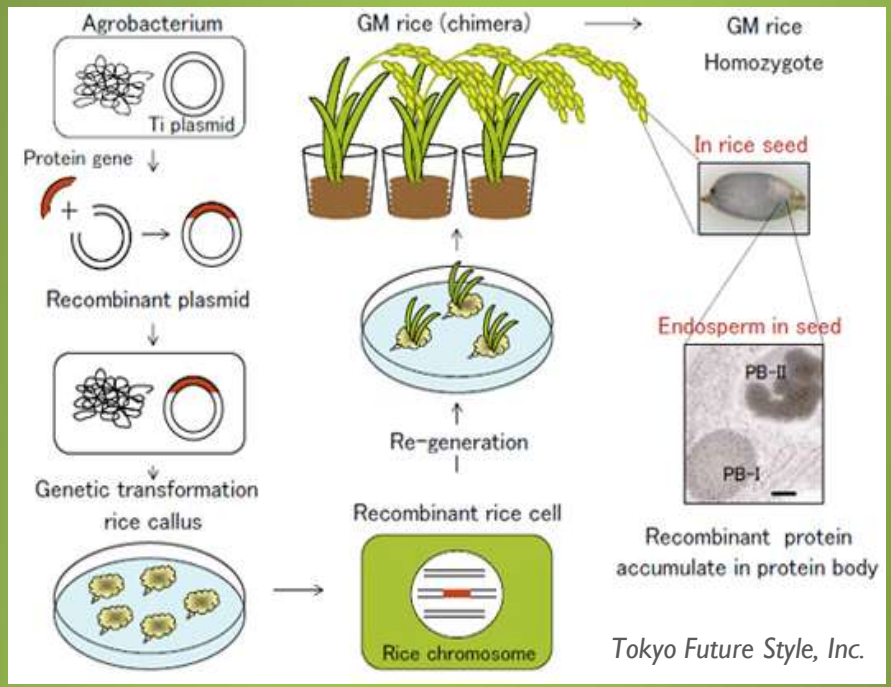


Image: Ricepedia

BIOPHARMA: CROPS THAT PRODUCE DRUGS

Transition from traditional pharmaceutical into biopharmaceutical

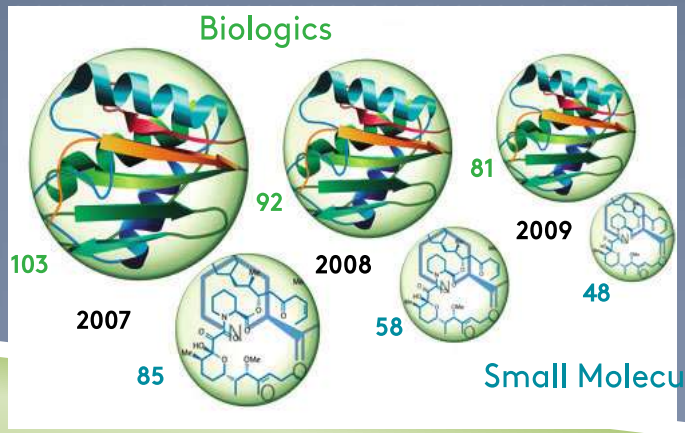
TRADITIONAL PHARMA

- Source – chemical synthesis
- Size – small-molecule drug
- Composition – organic molecule
- Advantage – oral intake

BIOPHARMA

- Source – biological with genetic modification
- Size – large, complex molecule drug
- Composition – complex protein
- Advantages – target-specific; increased potency, fewer side effects

Patent Gap is widening



Mean Number of patents files by the 10 Leading Drug Companies

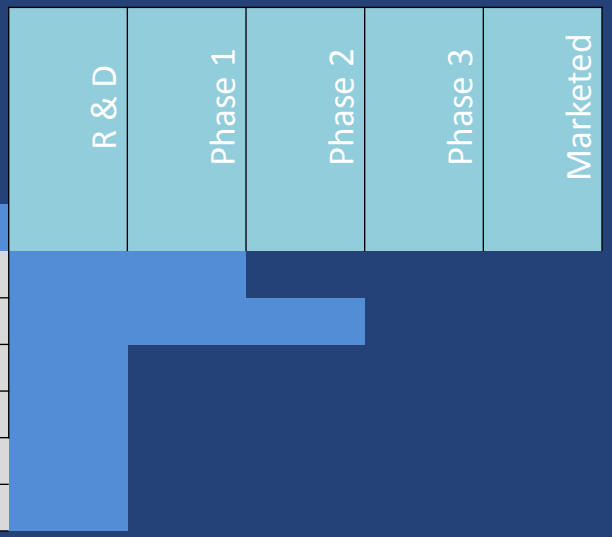
Source: Withers & Rogers

Jones, N., Dean, A., Pharm. Pat. Anal., 2012, 1: 225-7.

DEVELOPMENT OF RICE-BASED EDIBLE DRUGS

NOVEL Rice-based THERAPEUTICS

Product	Indication	Year
MucoRice	*Oral cholera vaccine*	2016
VEN100	*Antibiotic-associated diarrhea*	2012
rFGF-2	*Tissue repair*	2013
rHSA	*Hemorrhagic shock, burn injuries, cirrhotic ascites*	2011
rTr	*Safe and low-cost alternative to blood-derived transferrin*	2010
AAT	*Safe and low-cost alternative to alpha-antitrypsin*	2012



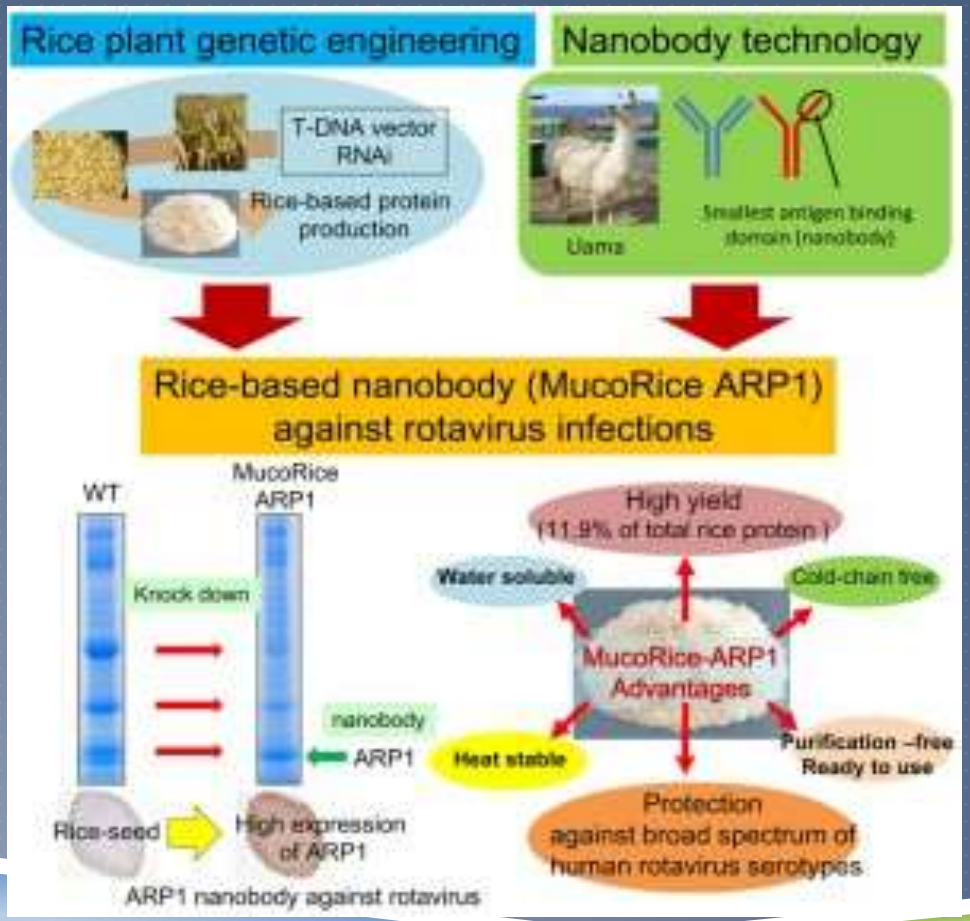
MucoRice: ANTIBODY-PRODUCING RICE RECENTLY IN CLINICAL TRIAL

Advantages of rice-derived drug:

- Cost-effective
- Scalability (bioreactors)
- Resistance to stomach enzymatic digestion
- Avoid contamination from human pathogens

Nochi., T. *et al.* Proc. Nat Acad Sci ., 2007, 104:10986-91.

Process of introducing the rotavirus antibody into the rice genome



"A bowl of rice a day, keeps the needle away."

Tokuhara., D. *et al.* J. Clin. Invest., 2013, 1: 225-7.

Japan

MucoRice

astellas
Leading Light for Life

Philippines few list of plant-based drugs:

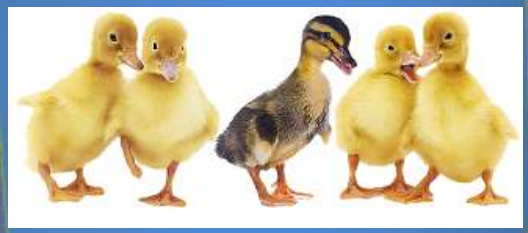
1. ASCOF Lagundi (cough)
2. RE-LEAF Sambong (diuretic)
3. Ampalaya Plus (blood-sugar))

Paradigm shift towards rice innovation

PHILIPPINE RICE BIOPHARMA: VISION & STRATEGIES TO MEET CHALLENGES

VISION

Rice research **innovation** to bring novel therapies to patients



Innovation born from diversity

STRATEGIES

Collaborative research in both local and international platforms (e.g. ASEAN)

Re-structure policy & management of R&D projects

Build a world-class innovation ecosystem

CHALLENGES

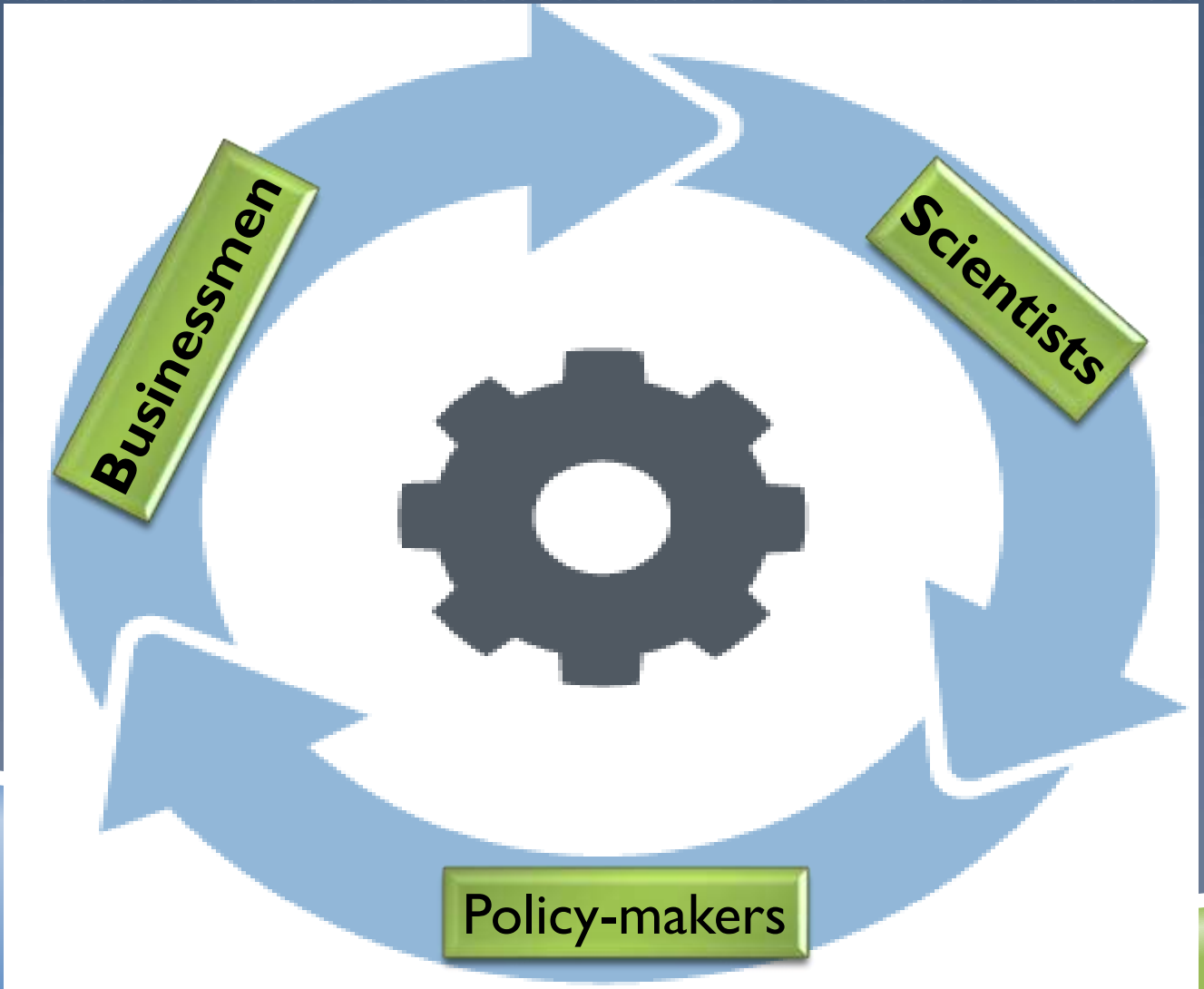
Inadequate technically capable R&D manpower

Weak structure, unfocused R&D projects

Shortage of R&D investment

Rethink: funding bottleneck

CONSENSUS EFFORT IN BIOTECH RESEARCH FOR DEVELOPMENT



SWOT ANALYSIS

PHILIPPINES RICE BIOPHARMACEUTICAL

Strength	Key issue	Opportunity
Existing infrastracture (PhilRice)	A strong strategy must leverage collaboration to exploit talent & resources	Build counterpart research team with IRRI, and international lead experts
Increasing economic stability & safety in business environment	A strong strategy must influence SC to favor biotech research & commercialization	Grow investment in R&D, and become competitive with ASEANs S&T dev't

SWOT ANALYSIS

PHILIPPINES RICE BIOPHARMACEUTICAL

Weakness	Key issue	Threat
Bureaucracy in allocation of research funds	A strong strategy must have transparency & efficiency in gov't research funding	Remain less competitive in biotech compared to neighboring ASEAN countries
Lack of support for a scientific culture	A strong strategy must foster young generation into science	Brain-drain, talented filipino scientists remained abroad resulting to shortage of manpower technical competence

RICE BIOPHARMACEUTICAL RESEARCH (RBR) IN THE PHILIPPINES TOWARDS CUTTING-EDGE THERAPEUTICS

The Economist Intelligence Unit Limited 2015

While research innovation greatly impacts rice security, would RBR be a threat ?

Solution: Establish a glasshouse facility

ACHIEVING SUCCESSFUL RBR PROJECT IN THE PHILIPPINES

R&D Talent

Science-people is the key to knowledge creation and success in R&D

R&D Process

Identify areas of cost, risk and bottlenecks

If necessary, outsource other experimental protocols

R&D Market Technology

Translates innovative drug into market, by partnering with pharmaceutical company

Drives economic growth

ACKNOWLEDGEMENT

PhilRice

Evora university, Portugal

A-STAR, Singapore

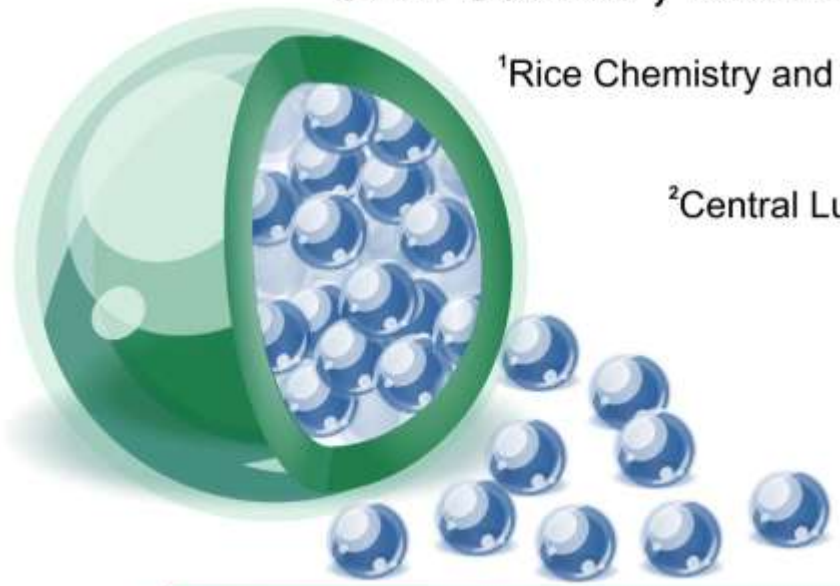
Photo: Wikipedia

Encapsulation of anthocyanin from black rice (*Oryza sativa* L.) bran extract using chitosan-alginate nanoparticles

JPA Samin[1], RM Bulatao[1], JJ Monserate[2], JR Salazar[2]

[1]Rice Chemistry and Food Science Division, Philippine Rice Research Institute
Maligaya, Science City of Muñoz, Nueva Ecija

[2]Central Luzon State University, Science City of Muñoz, Nueva Ecija



Presentation Flow

- Introduction
  - Rice and its By-products
  - Anthocyanins
  - Encapsulation Technology
- Objectives of the Study
- Materials and Methods used
- Findings of the Study
- Conclusions
- For Future Works

18.15 million metric tons of palay in 2015 (PSA, 2016)

Rice By-products

Hull

Stalks

Bran

Fibers

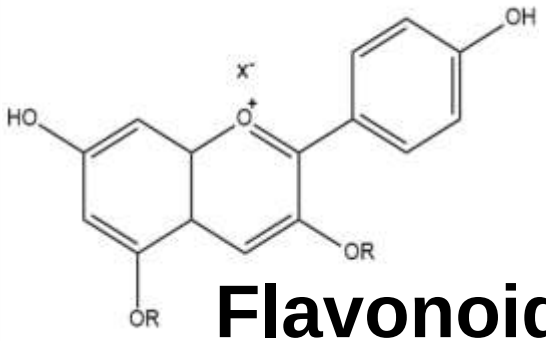
Proteins

Minerals

Pigmented Rice Varieties

Anthocyanins

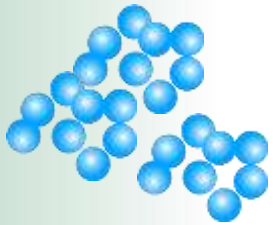
Anthocyanins



Flavonoid

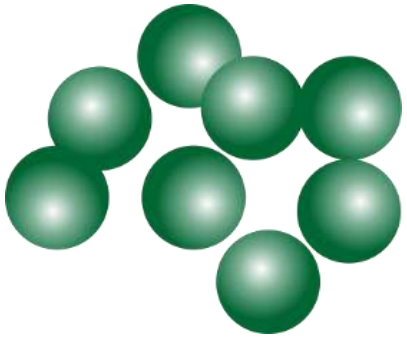
reactive and unstable

Encapsulation Technology



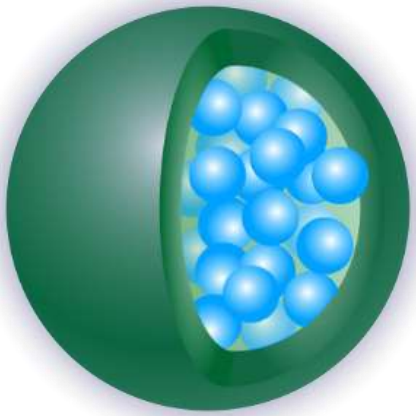
Bioactive Compound

+



Encapsulating Material

→

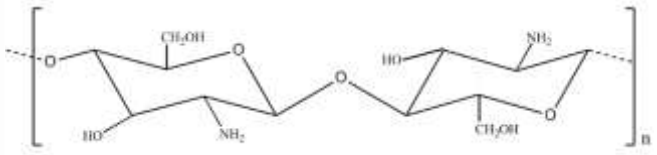


Nano/Microcapsules

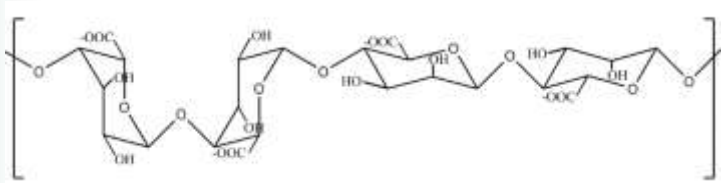
1 µm < Micro < 1000 µm

1 nm < Nano < 1000 nm

Chitosan and Alginate



Chitosan



Alginate

Objectives of the Study

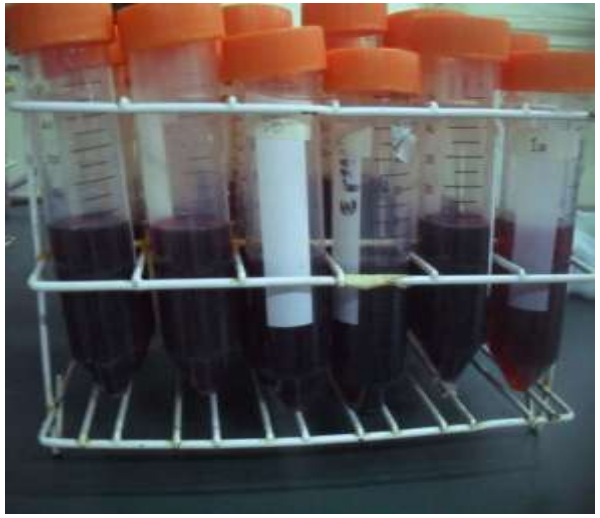
- To *screen* black rice bran with the highest anthocyanin *content*
- To *encapsulate* anthocyanin using chitosan-alginate
- *To characterize* anthocyanin-loaded capsules
- To *evaluate* its encapsulation efficiency and antioxidant activity

Materials & Methods

Rice Processing

Rough Rice ----------> Rice Bran

Anthocyanin Screening of Rice Bran Samples



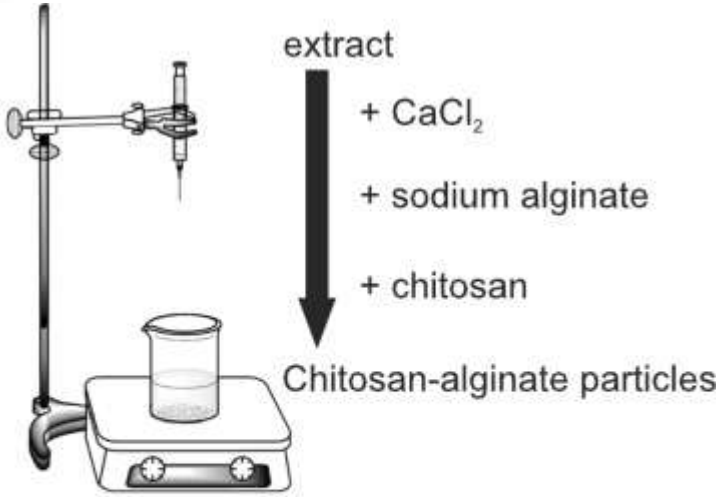
Extraction of Anthocyanin

Defatting → acidified ethanol extraction

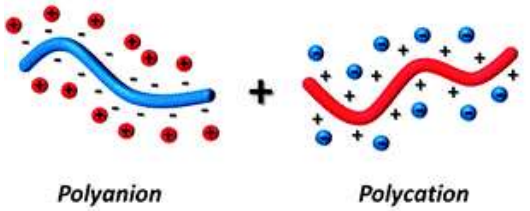
Freeze drying

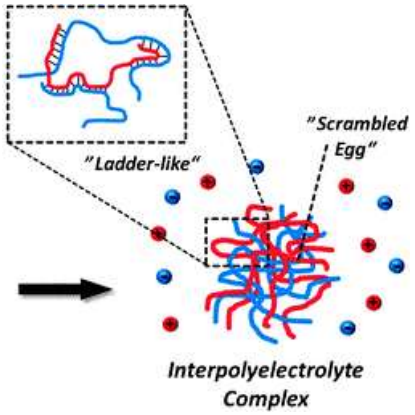
Freeze-dried extract

Encapsulation



Formation of polyelectrolyte complex





Encapsulation Treatments

Treatments	Composition
T0	Blank chitosan-alginate
T1	Chitosan-alginate + 10 mg CAE
T2	Chitosan-alginate + 20 mg CAE
T3	Chitosan-alginate + 30 mg CAE

Characterization and Evaluation of the Anthocyanin-loaded Capsules

Characterization

- Chemical Properties
- Surface Morphology
- Particle Size

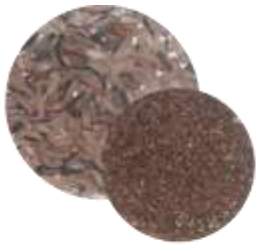
Evaluation

- Encapsulation Efficiency
- Antioxidant Activity

Results

Rice Samples


Masbate


Galo 1


Pirurutong


Labitaris


Ominio


Galo Malagkit

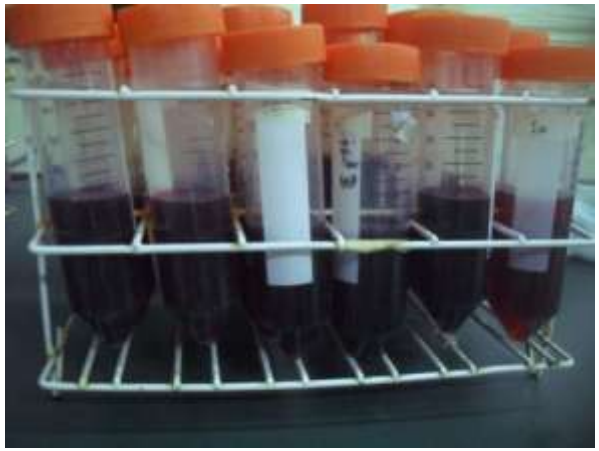

Palanqui


Kotinaw

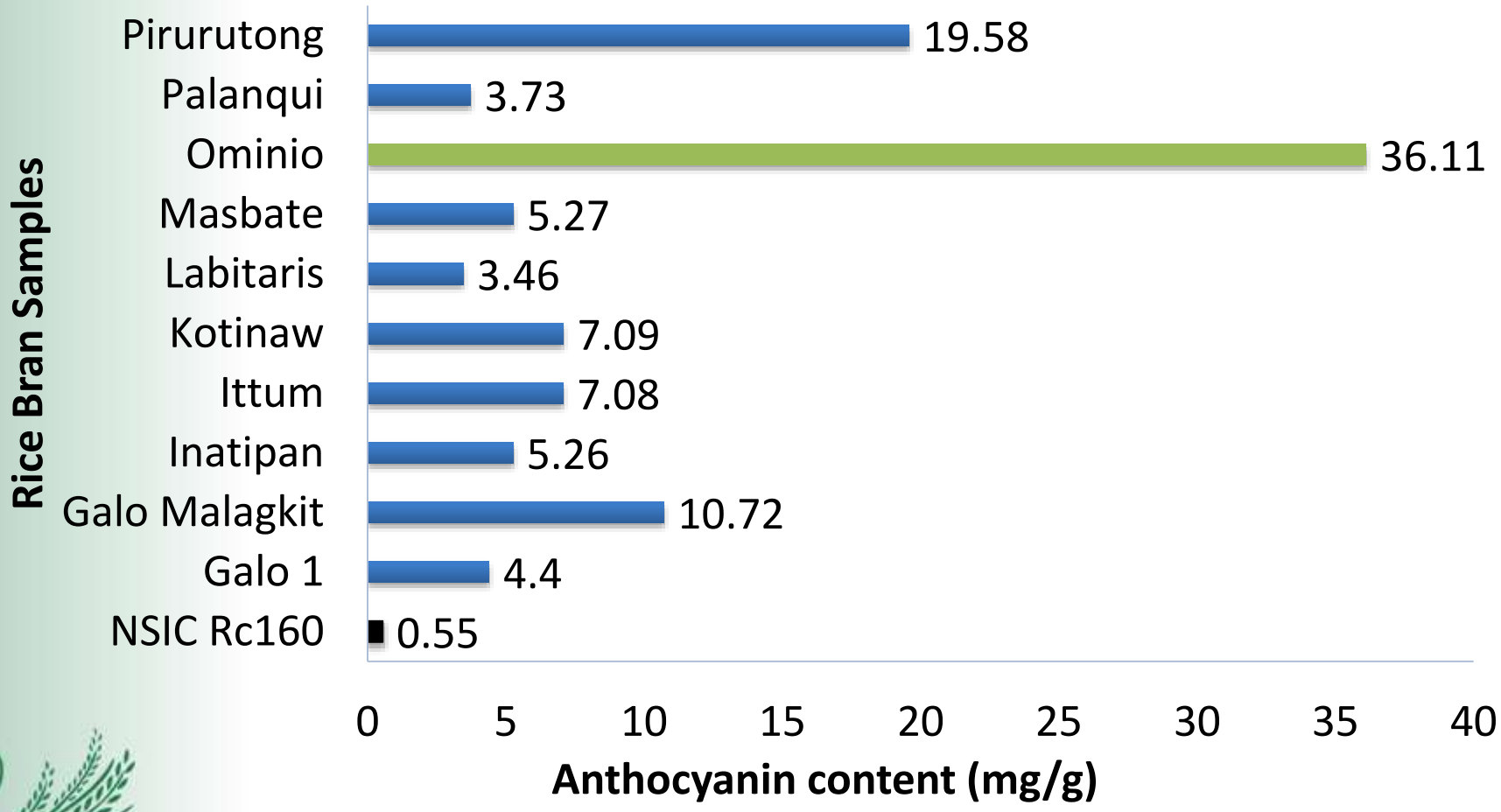

Ittum


NSIC Rc160

Screening of Rice Bran Samples



Anthocyanin Content of Rice Samples



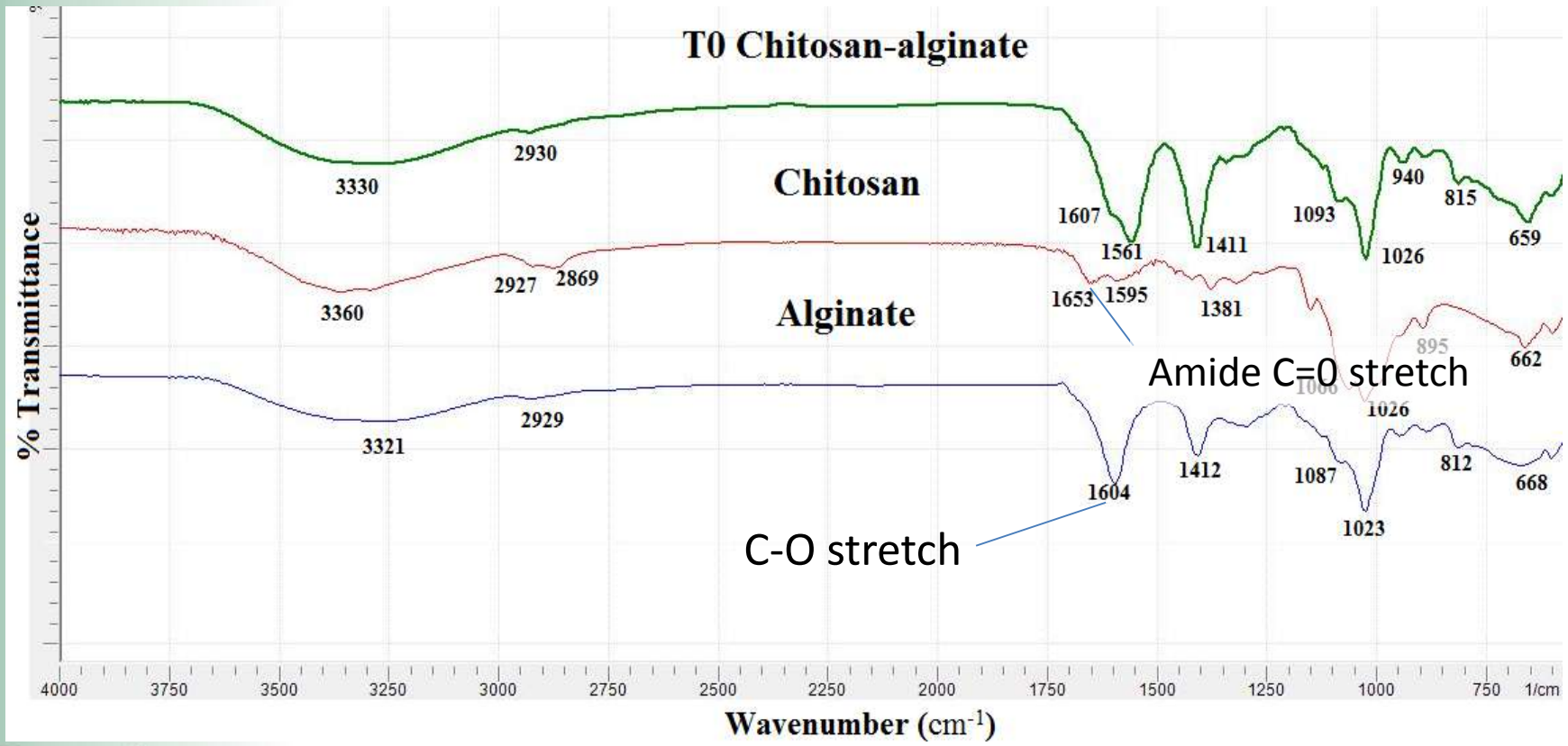
Characterization

Chemical Properties

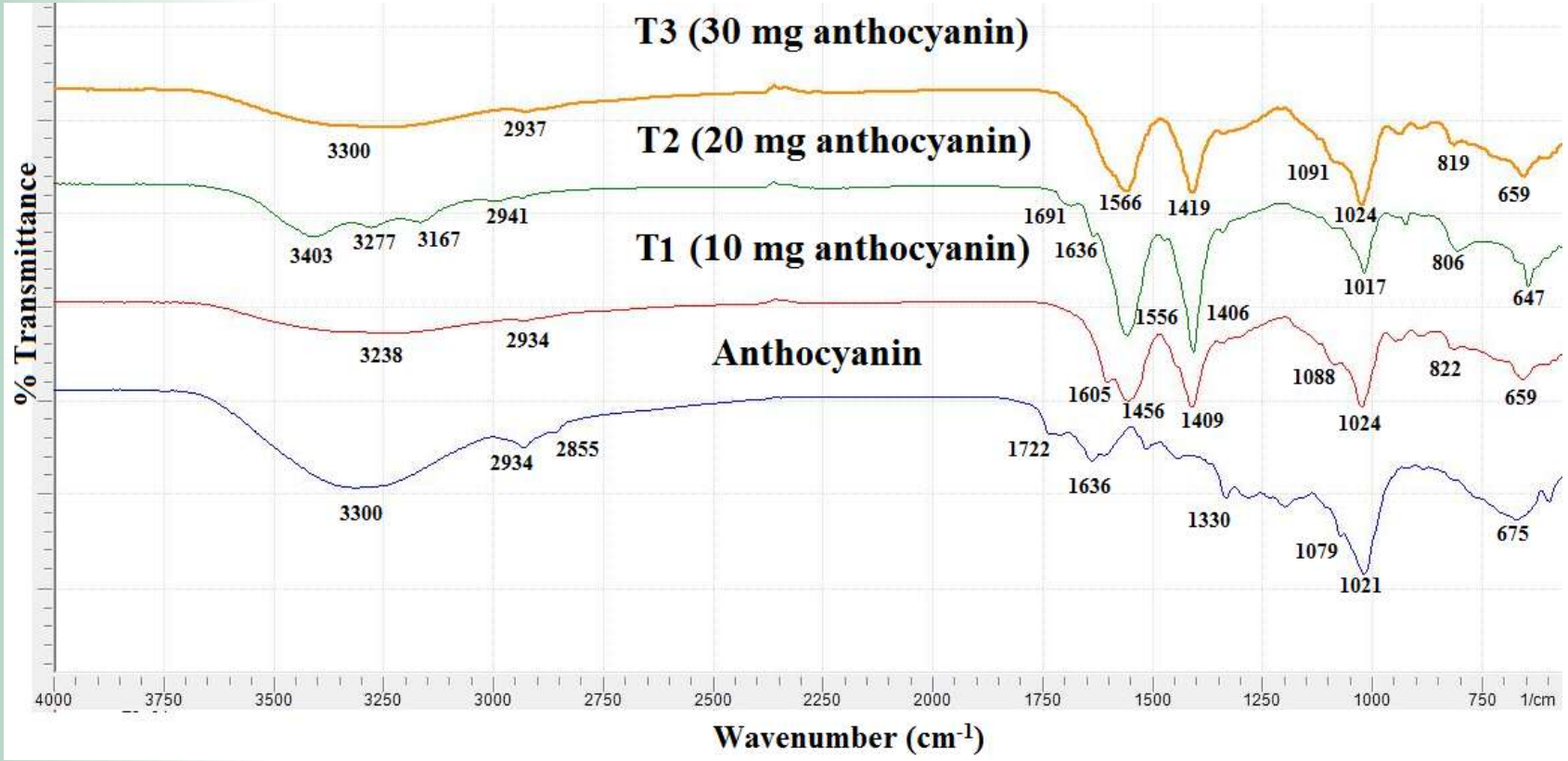
Fourier Transfrom Infrared Spectroscopy

Horizon MB3000

FTIR spectra of Chitosan-alginate



FTIR spectra of loaded capsules



Characterization

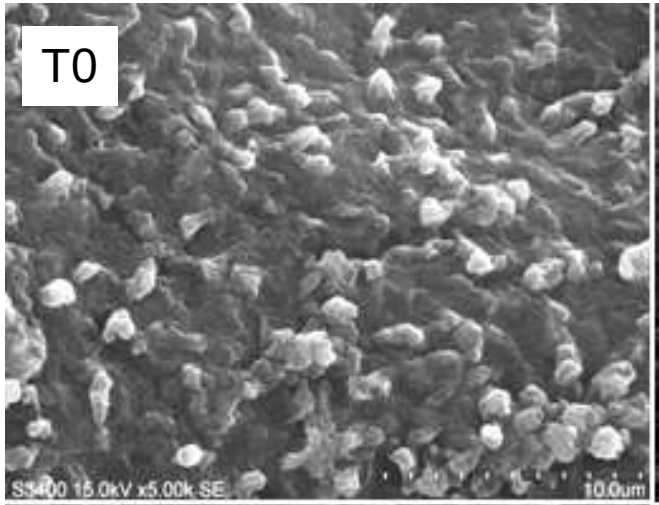
Surface Morphology

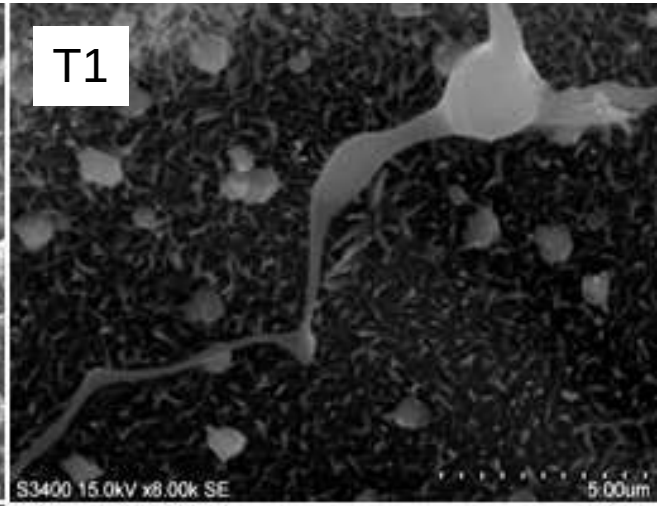
Scanning Electron Microscopy

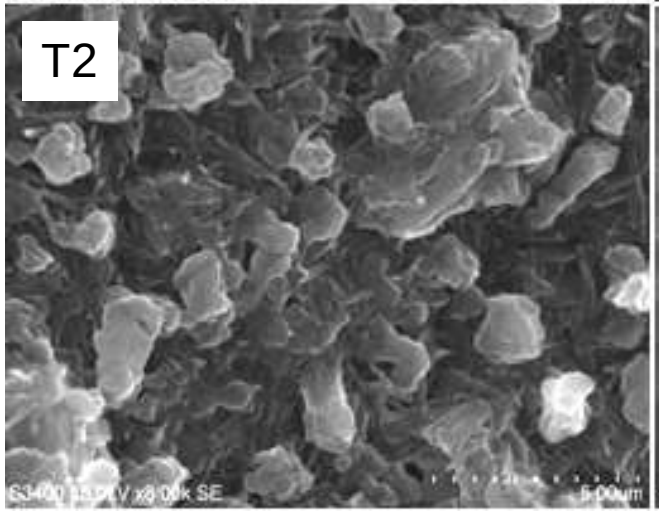
Ion Sputter (Hitachi E1010)

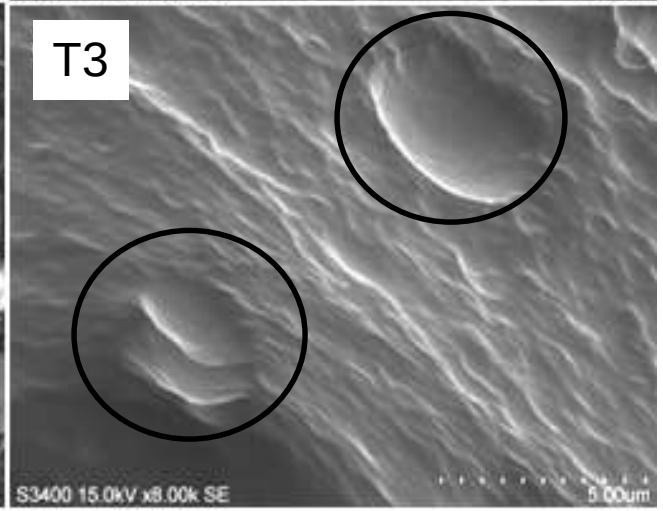
SEM (Hitachi S3400N)

SEM Images


T0
S3400 15.0kV x5.00k SE
10.0um


T1
S3400 15.0kV x8.00k SE
5.00um


T2


T3
S3400 15.0kV x8.00k SE
5.00um

Characterization

Particle size (Zeta Sizer)

Treatment	Mean Particle Size (nm)	Polydispersive Index
T0	358.5±73.2^{a}	0.57±0.02^{b}
T1	572.3±125.8^{b}	0.69±0.09^{bc}
T2	635.9±88.4^{b}	0.76±0.07^{c}
T3	467.8±17.0^{ab}	0.31±0.08^{a}

Evaluation

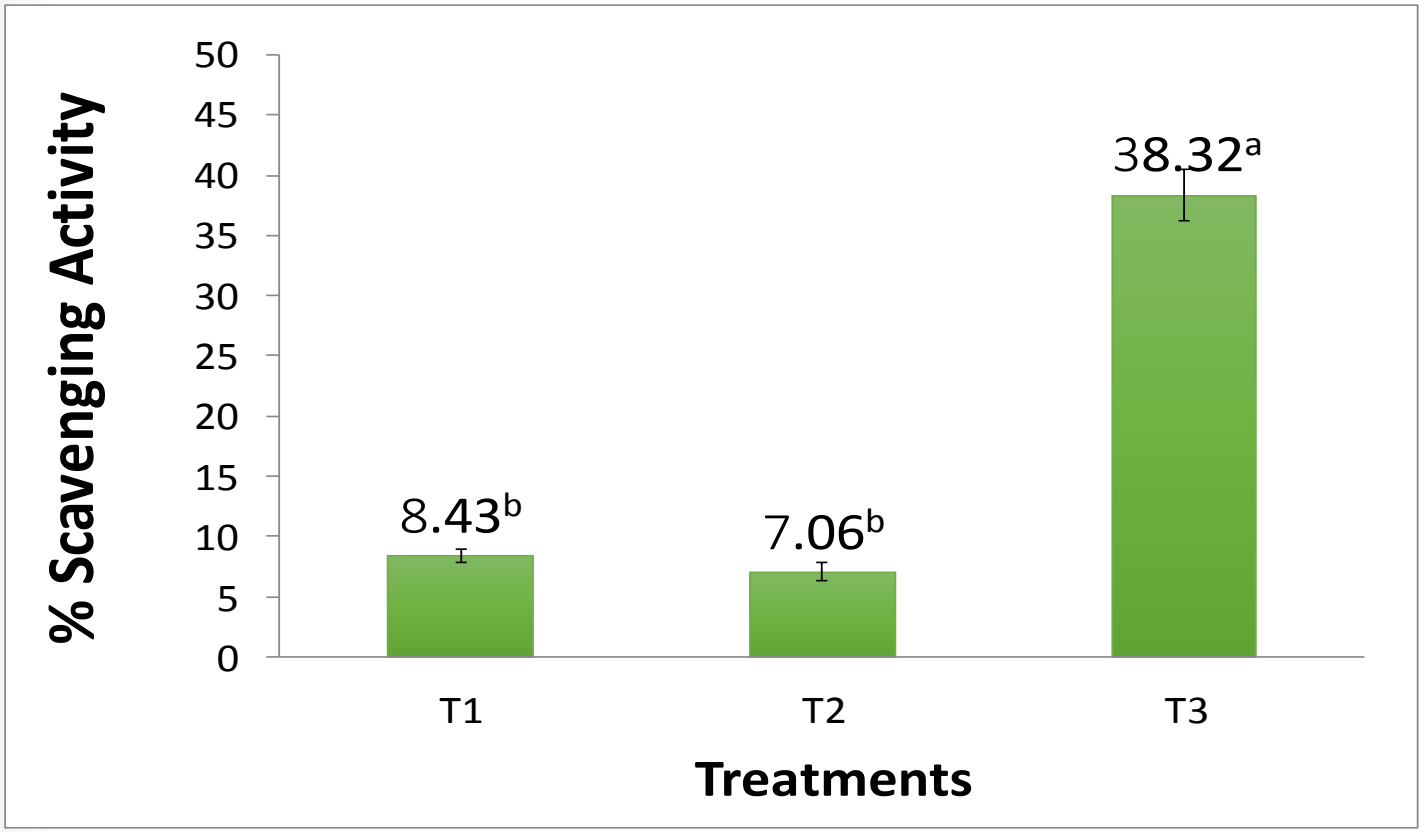
Encapsulation Efficiency

UV-Vis Spectrophotometric method

Treatments	Encapsulation Efficiency (%)
T1	56.87 ± 0.08^{b}
T2	56.34 ± 0.60^{b}
T3	68.92 ± 1.29^{a}

Evaluation

DPPH radical scavenging activity



Conclusions

- ***Ominio*** bran was found to contain the highest amount of anthocyanin
- Chitosan-alginate encapsulated the anthocyanin extracted from black rice bran with a final product of black to purple powder.

Conclusions

- ✓ Chemical properties → well-incorporated anthocyanin in the chitosan-alginate framework.
- ✓ Surface morphology → presence of free particles and clumping on the surface
- ✓ Particle size → nanocapsules

Conclusions

- ✓ T3 (30 mg CAE) → highest encapsulation efficiency and antioxidant scavenging activity

For Future Works

- ✓ Increase the amount of CAE to encapsulate to determine maximum loading capacity
- ✓ Determine the release profile of the capsules using in-vitro digestion and animal clinical trials to determine its effectiveness in-vivo

Thank you!

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Antioxidant Capacities of Raw and Cooked Forms of some Philippine Vegetables

Rosaly V. Manaois
John Edward I. Zapater
Amelia V. Morales
Rice Chemistry and Food Science Division

Antioxidants

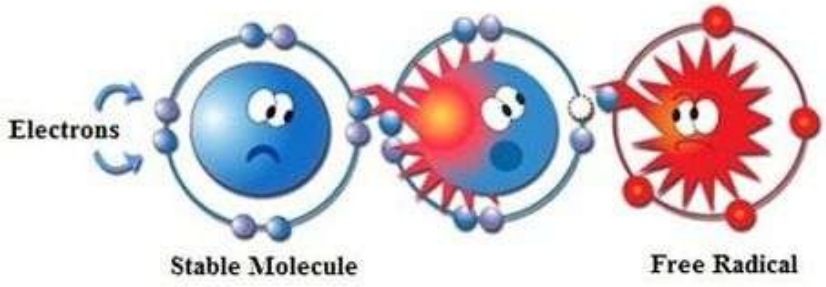
- Can be a vitamin, a mineral or a phytochemical

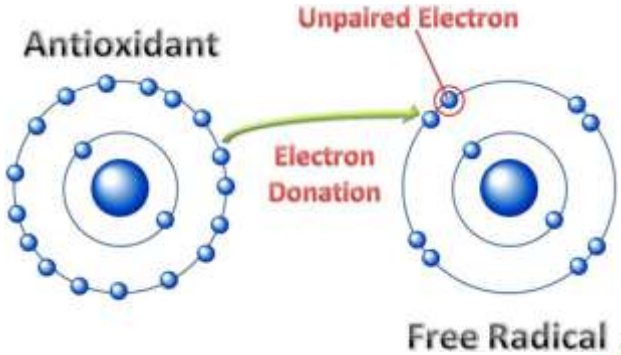
Ascorbic Acid

Selenium

Phenolics

- Able to prevent, delay or neutralize cellular damage.





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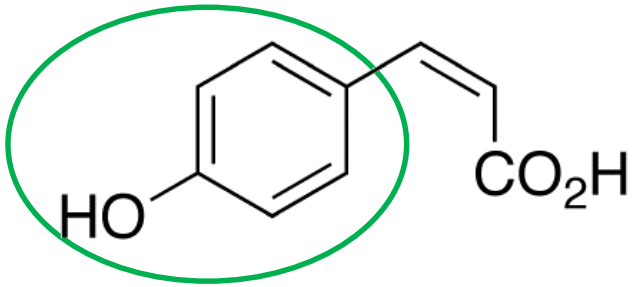
Phenolic Compounds

- Phytochemicals with hydroxyl constituents attached to a benzene ring.
- One of the most common compounds found in plants.
- Protect plants from environmental stresses.



Hydroxycinnamic acid

Heat

Cold

Bacteria and Viruses

The Current Picture

- Antioxidants in cultivated fruits and vegetables in many countries have been profiled.

- However, they have different:

Geography

Climate

Varieties

Farming Practices

- Limited data on antioxidant capacities of raw and cooked locally cultivated and consumed vegetables

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Objectives

- Measure the total phenolic content (TPC) of 21 vegetables commonly grown in rice-based farms.
- Determine the antioxidant capacities of the vegetables using two commonly used antioxidant assays:
  - 2,2-diphenylpicrylhydrazyl (DPPH)
  - 2,2-azinobis(2,3-benzothiazoline-6-sulfonic acid) (ABTS)
- Compare TPC and antioxidant capacities of raw and boiled vegetables.
- Correlate TPC with the DPPH and ABTS radical scavenging activities.

Methodology

Leafy and Salad Vegetables

Jute / Saluyot
(Corchorus olitorius)

Mustard / Mustasa
(Brassica juncea)

Chinese Cabbage / Pechay
(Brassica rapa)

Spinach / Alugbati
(Spinacia oleracea)

Water Spinach / Kangkong
(Ipomoea aquatica)

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Botanical Fruits

Bitter Gourd / Ampalaya
(Momordica charantia)

Bottle Gourd / Upo
(Lagenaria siceraria)

Eggplant / Talong
(Solanum melongena)

Lady's fingers / Okra
(Abelmoschus esculentus)

Squash / Kalabasa
(Cucurbita maxima)

Green Pepper / Siling Panigang
(Capsicum annuum)

Chili / Siling Labuyo
(Capsicum frutescens)

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Rhizome

Ginger / Luya
(Zingiber officinale)

Cereal

Corn / Mais
(Zea mays)

Tubers

Sweet Potato / Kamote
(Ipomoea batatas)

Edible Stalk

Taro / Gabi
(Colocasia esculenta)

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Edible Flower

Squash Flower / Bulaklak ng Kalabasa
(Cucurbita maxima)

Edible Mushroom

Oyster Mushroom / Kabute
(Pleurotus ostreatus)

Legumes

String Beans / Sitaw na Haba
(Vigna unguiculata subsp. Sesquipedalis)

Cowpea / Sitaw na Turo
(Vigna unguiculata)

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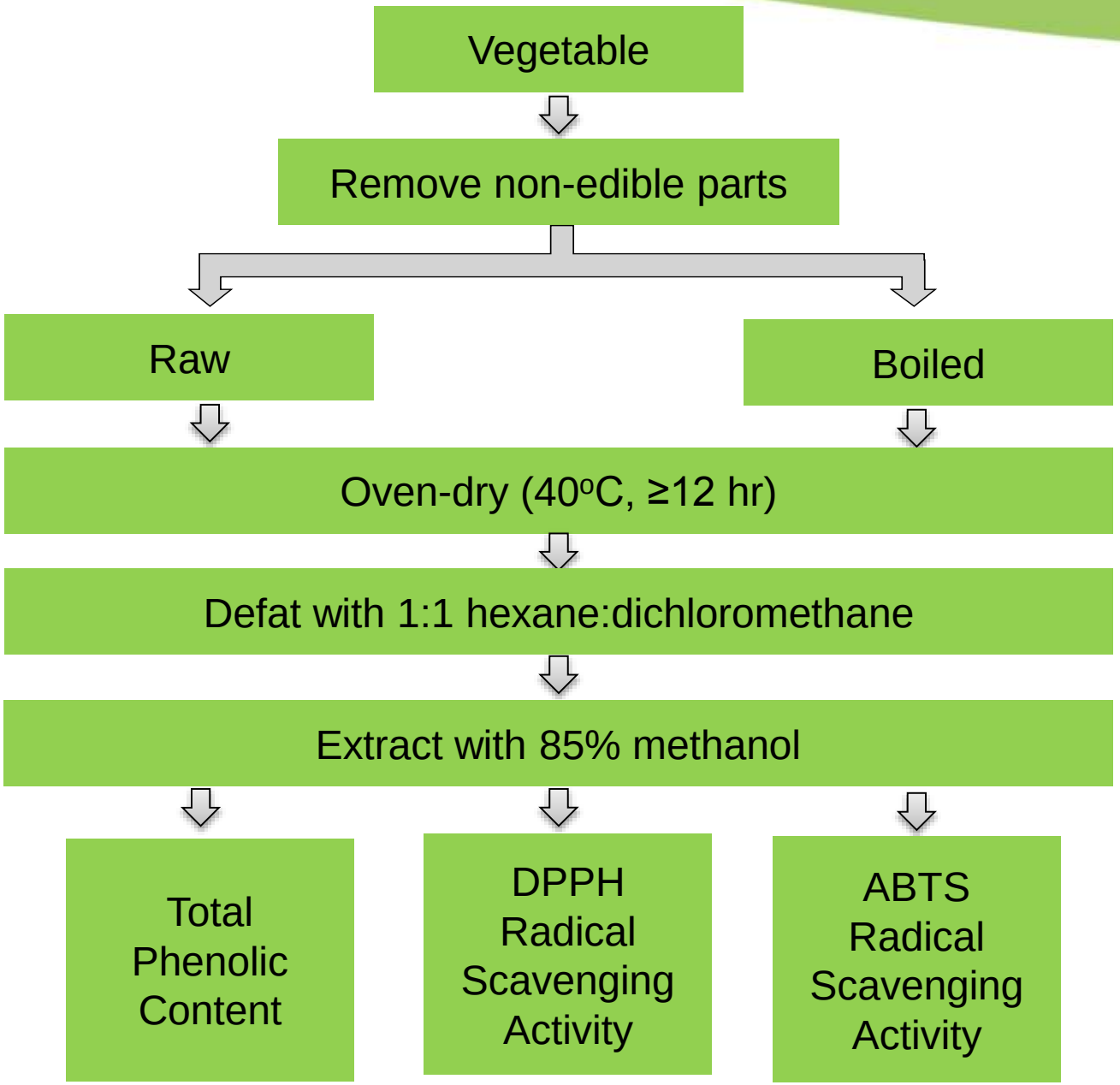
Methodology



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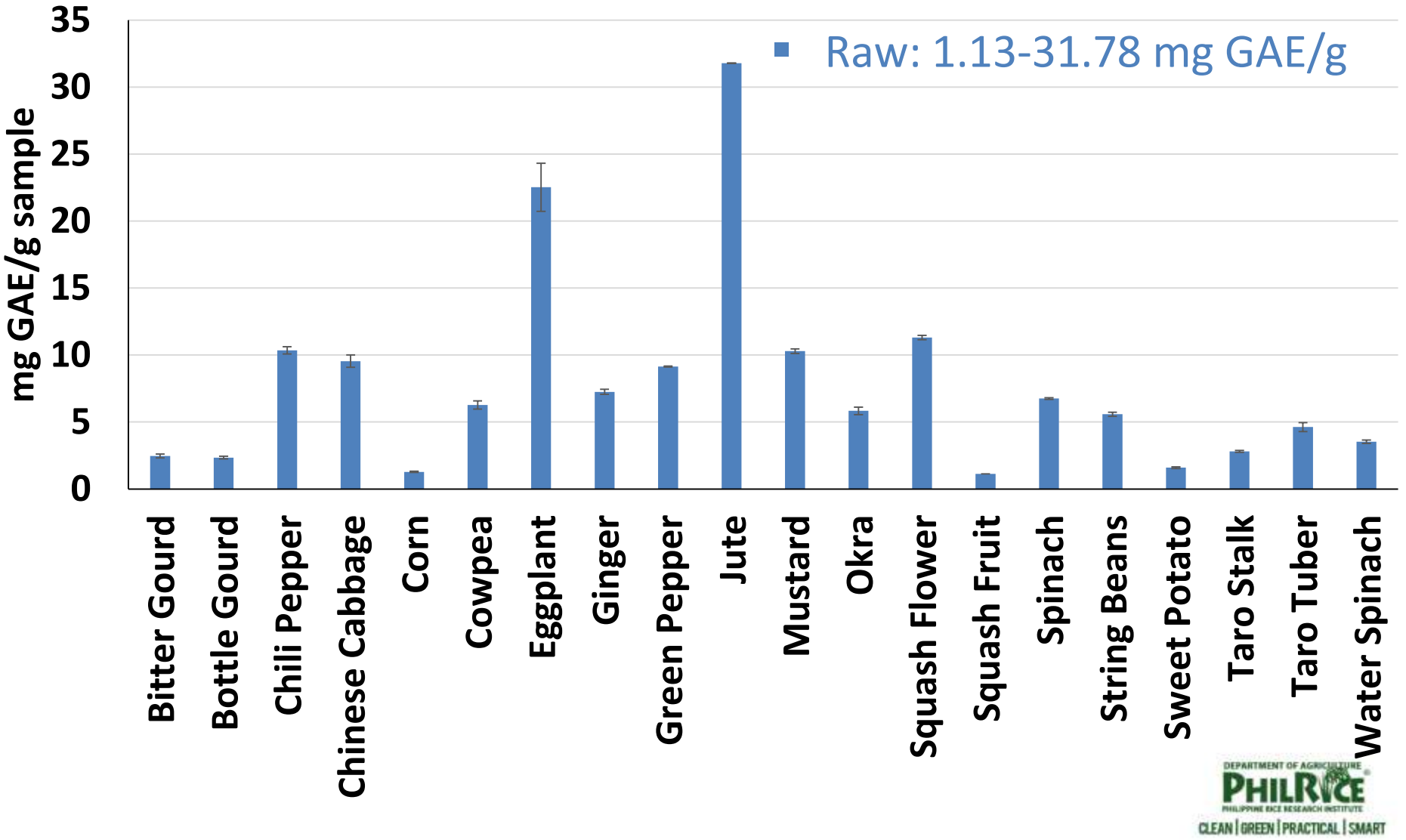
Results

Total Phenolic Content



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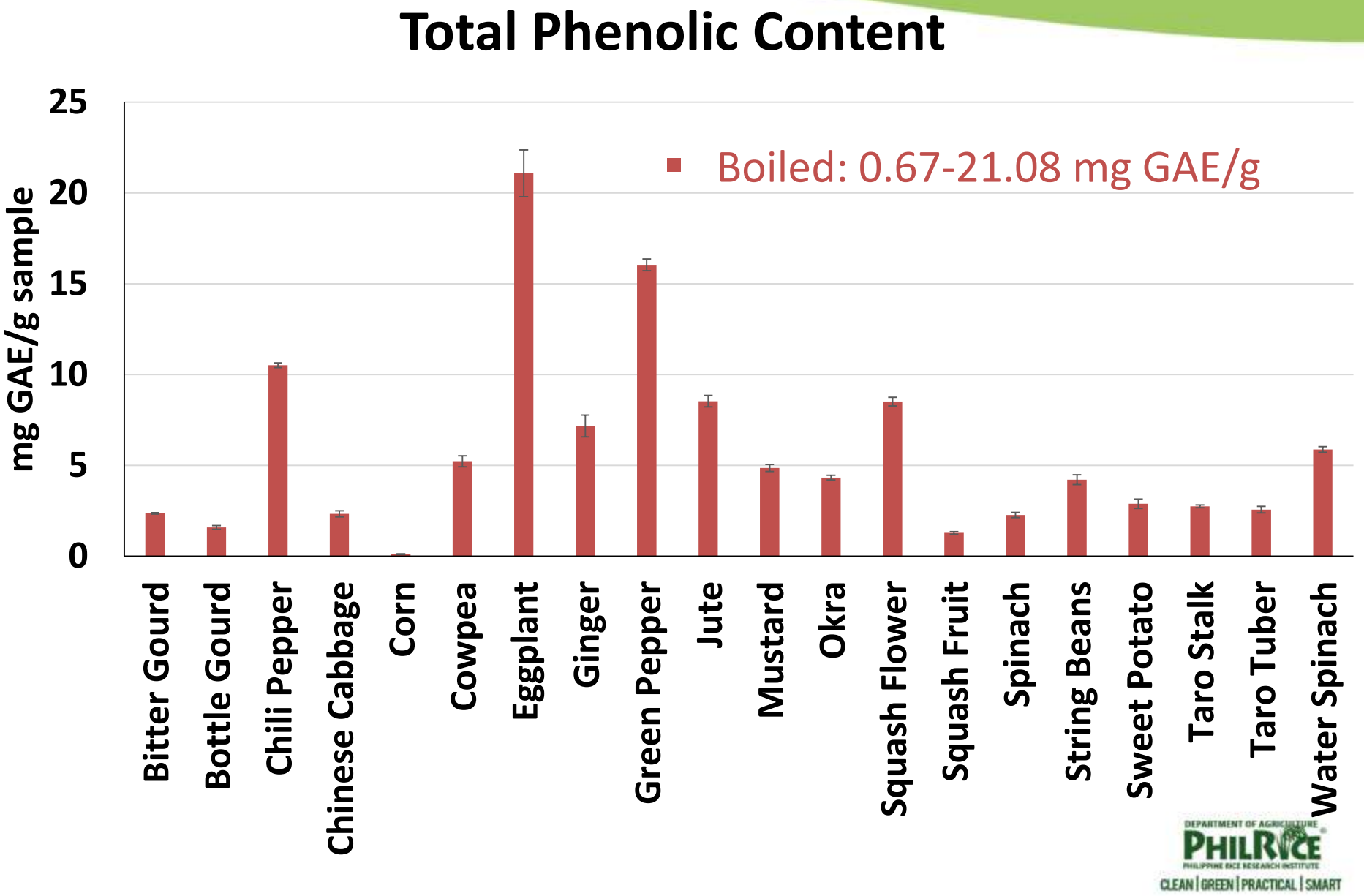
Results



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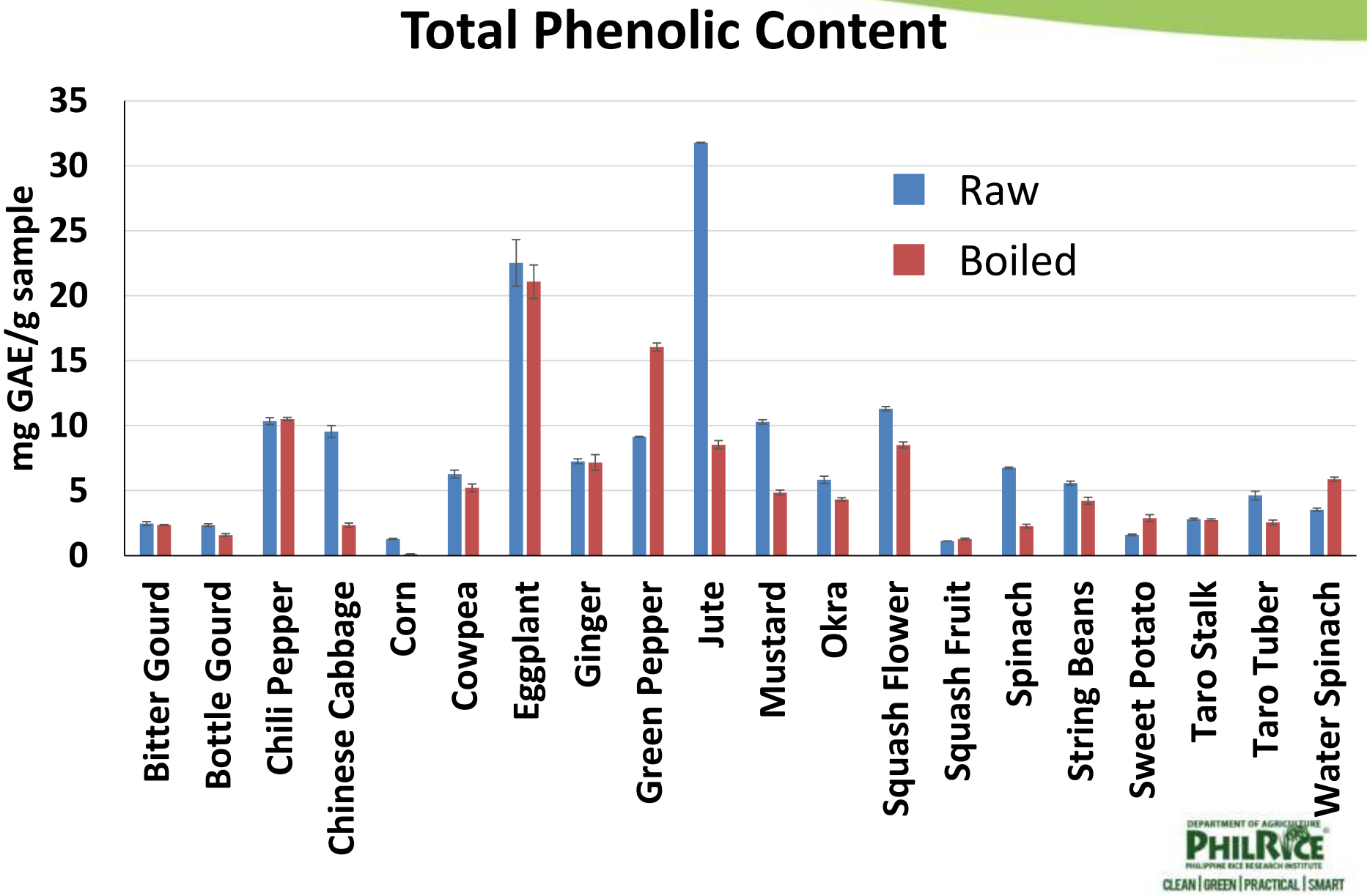
Results



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Summary: TPC

Top Vegetables

Raw

jute > eggplant > squash flower ≥ chili ≥ mustard ≥ chinese cabbage ≥ green pepper

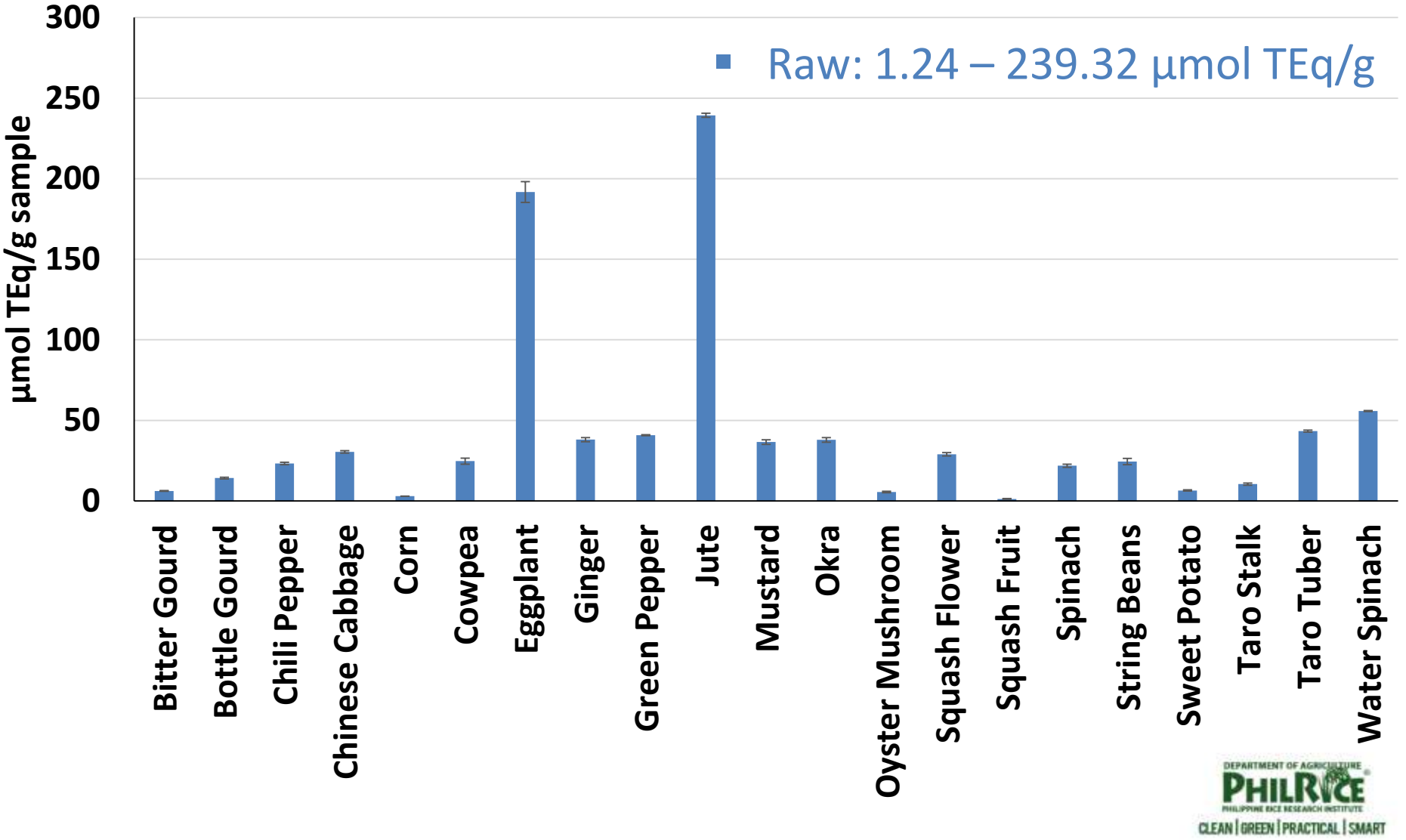
Boiled

eggplant > green pepper > chili > jute ≥ squash flower > ginger

Boiling generally induced up to 91% decrease

Results

DPPH Radical Scavenging Activity



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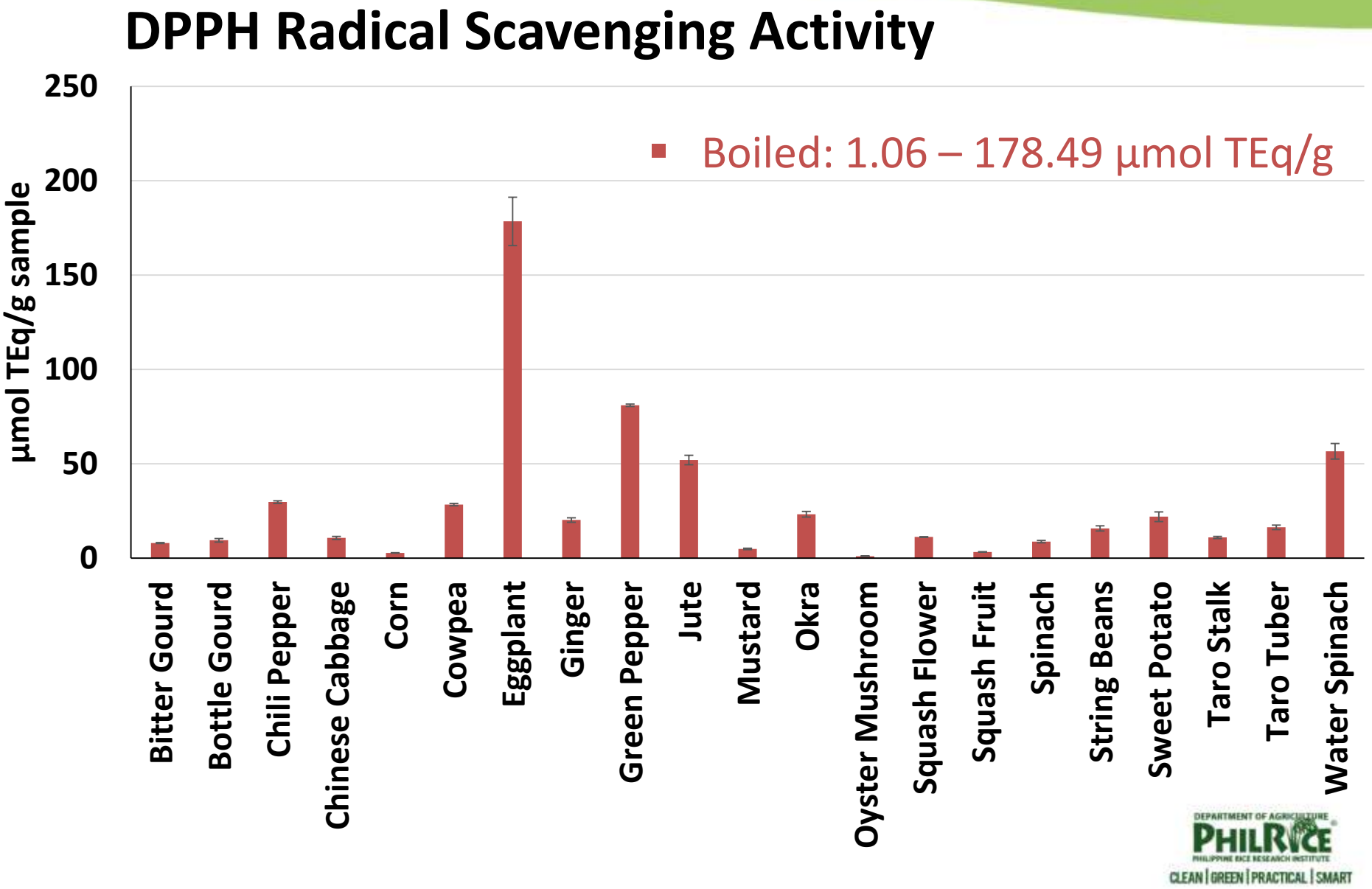
Results



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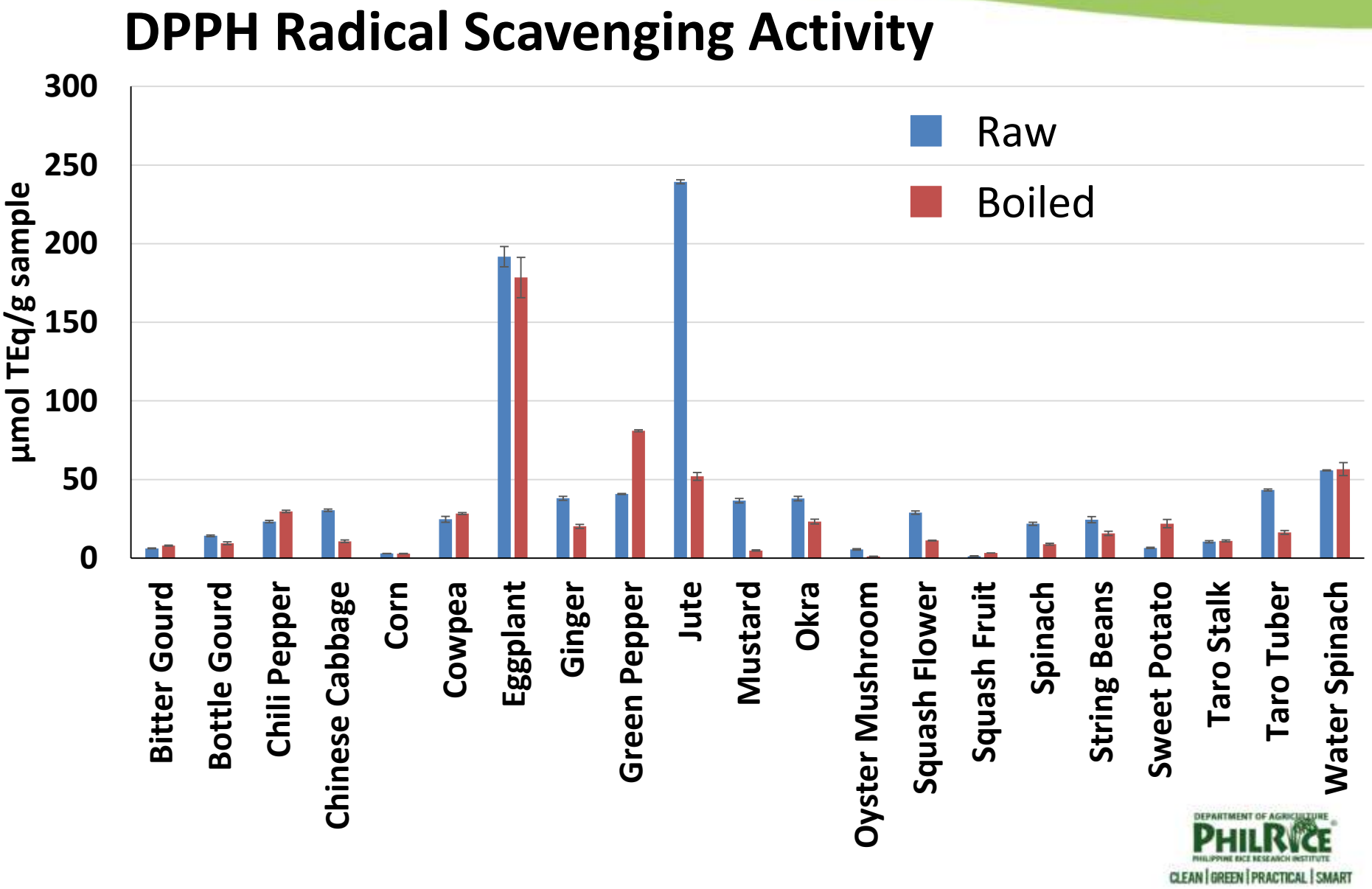
Results



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Summary: DPPH

Top Vegetables

Raw

jute > eggplant > water spinach > taro tuber ≥

green pepper ≥ ginger ≥ okra ≥ mustard

Boiled

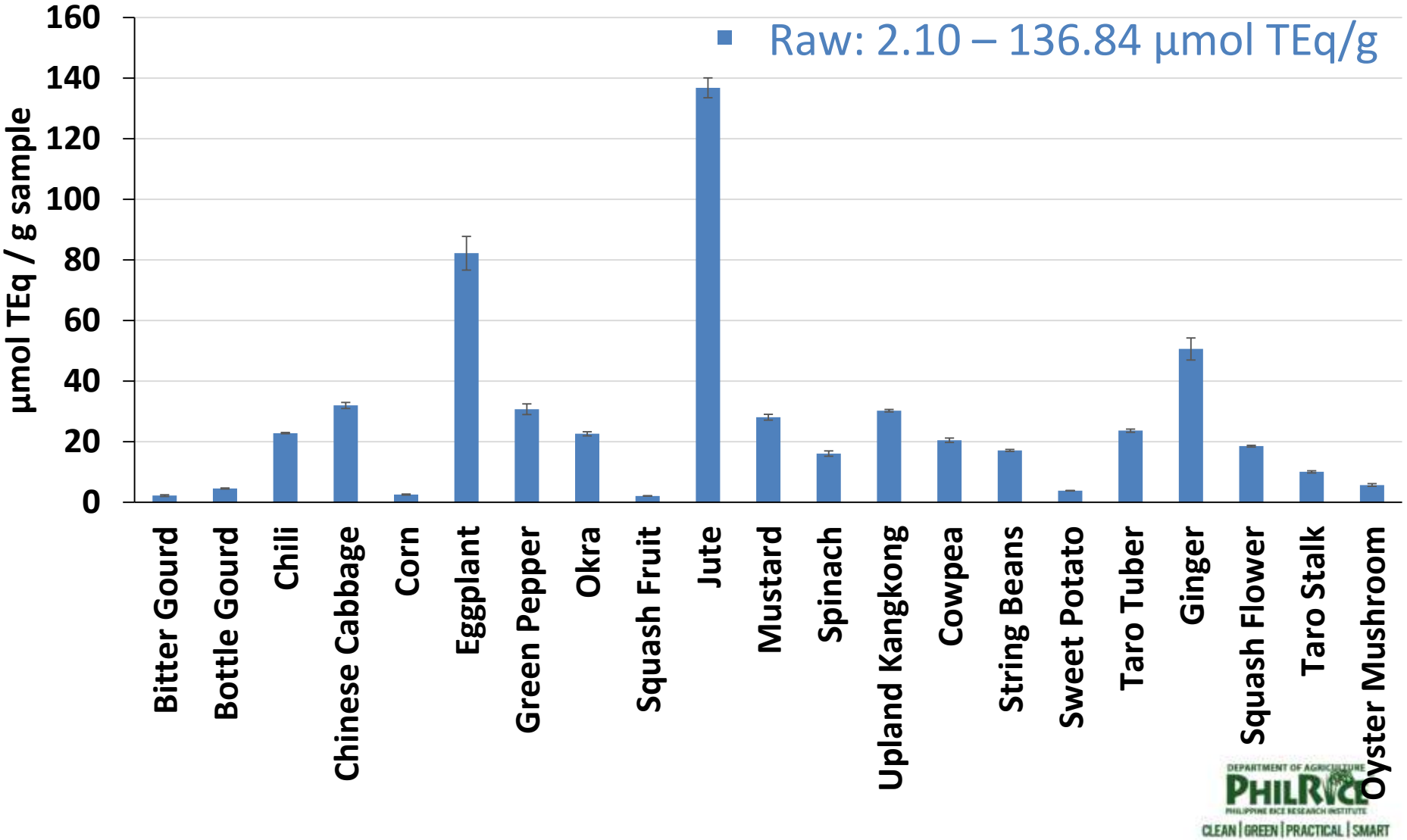
eggplant > green pepper > water spinach ≥ jute > chili ≥

cowpea ≥ okra ≥ sweet potato ≥ ginger

Boiling generally induced up to 81% decrease

Results

ABTS Radical Cation Scavenging Activity



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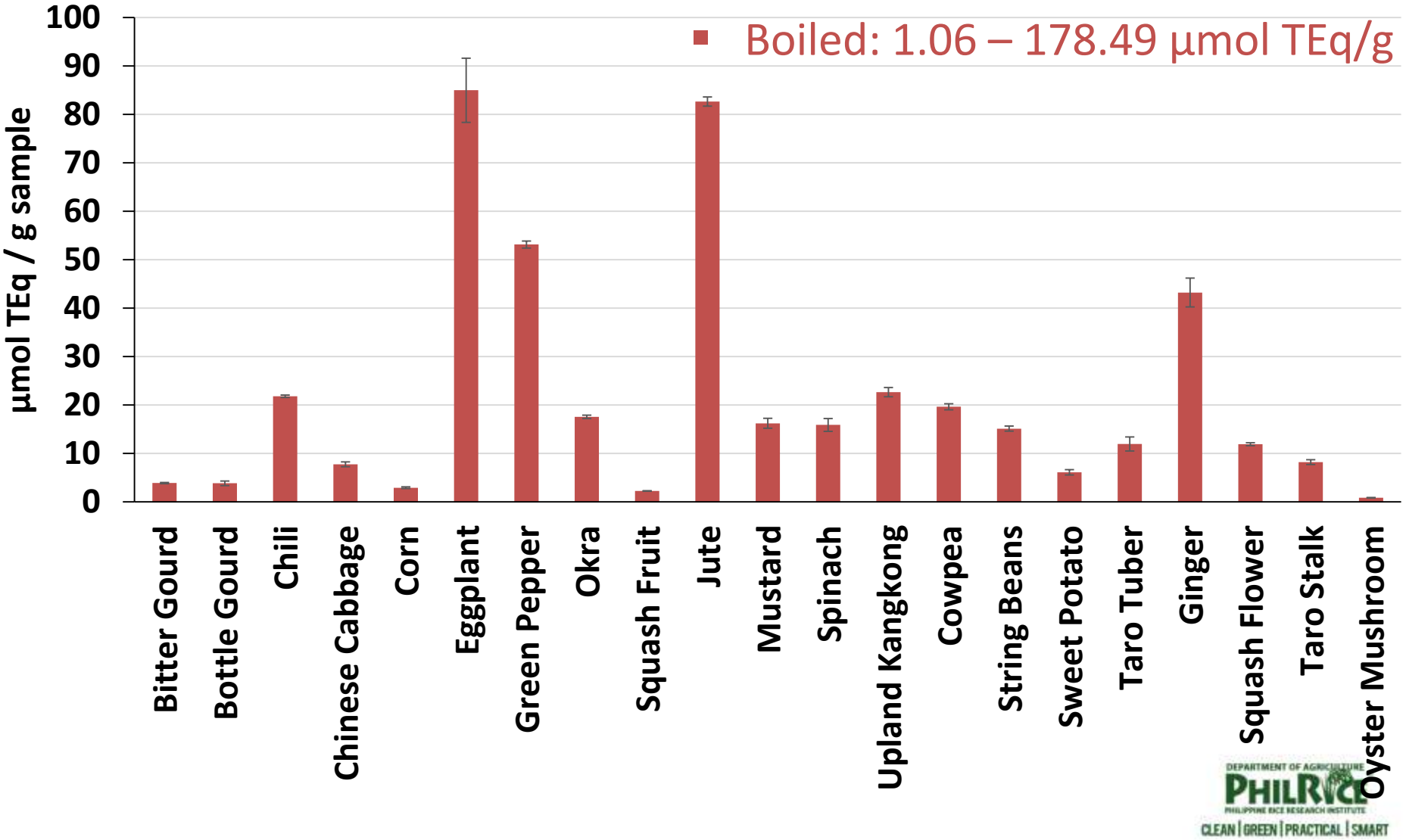
Results

ABTS Radical Cation Scavenging Activity



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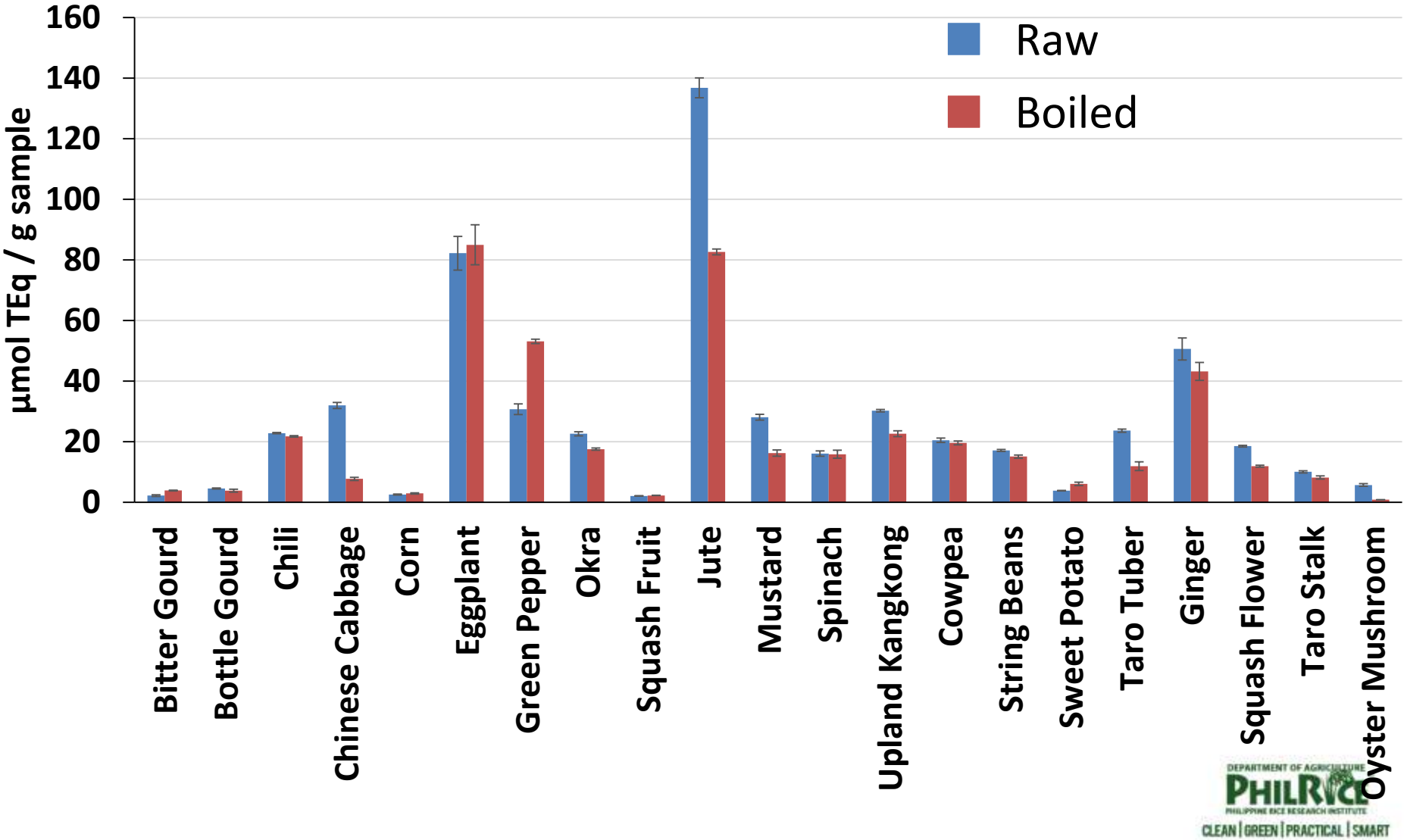
Results

ABTS Radical Cation Scavenging Activity



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Summary: ABTS

Top Vegetables

Raw

jute > eggplant > ginger > mustard ≥

water spinach ≥ pechay ≥ green pepper

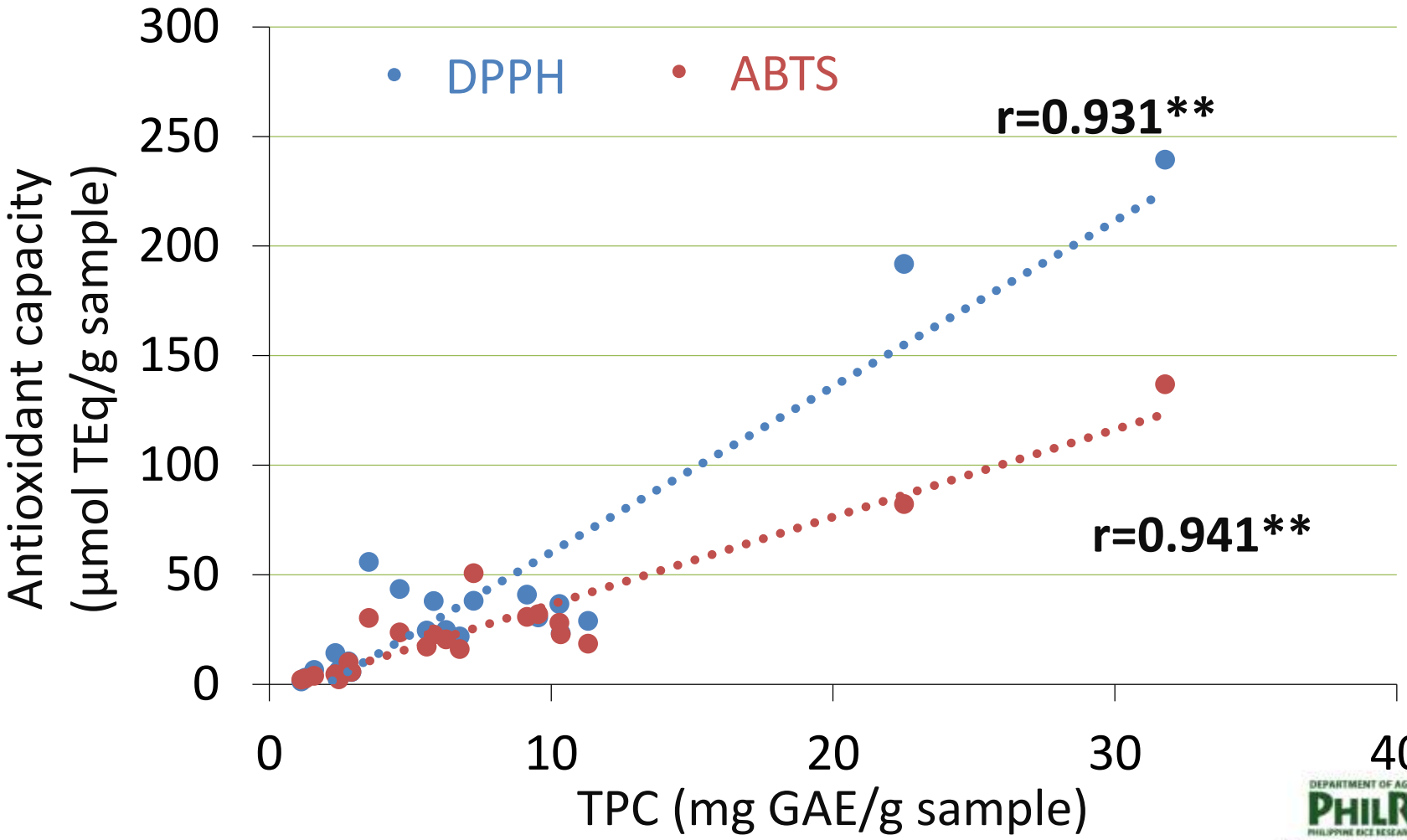
Boiled

eggplant ≥ jute > green pepper > ginger >
water spinach ≥ chili ≥ cowpea

Boiling generally induced up to 85% decrease

Correlation Analysis

Raw Samples



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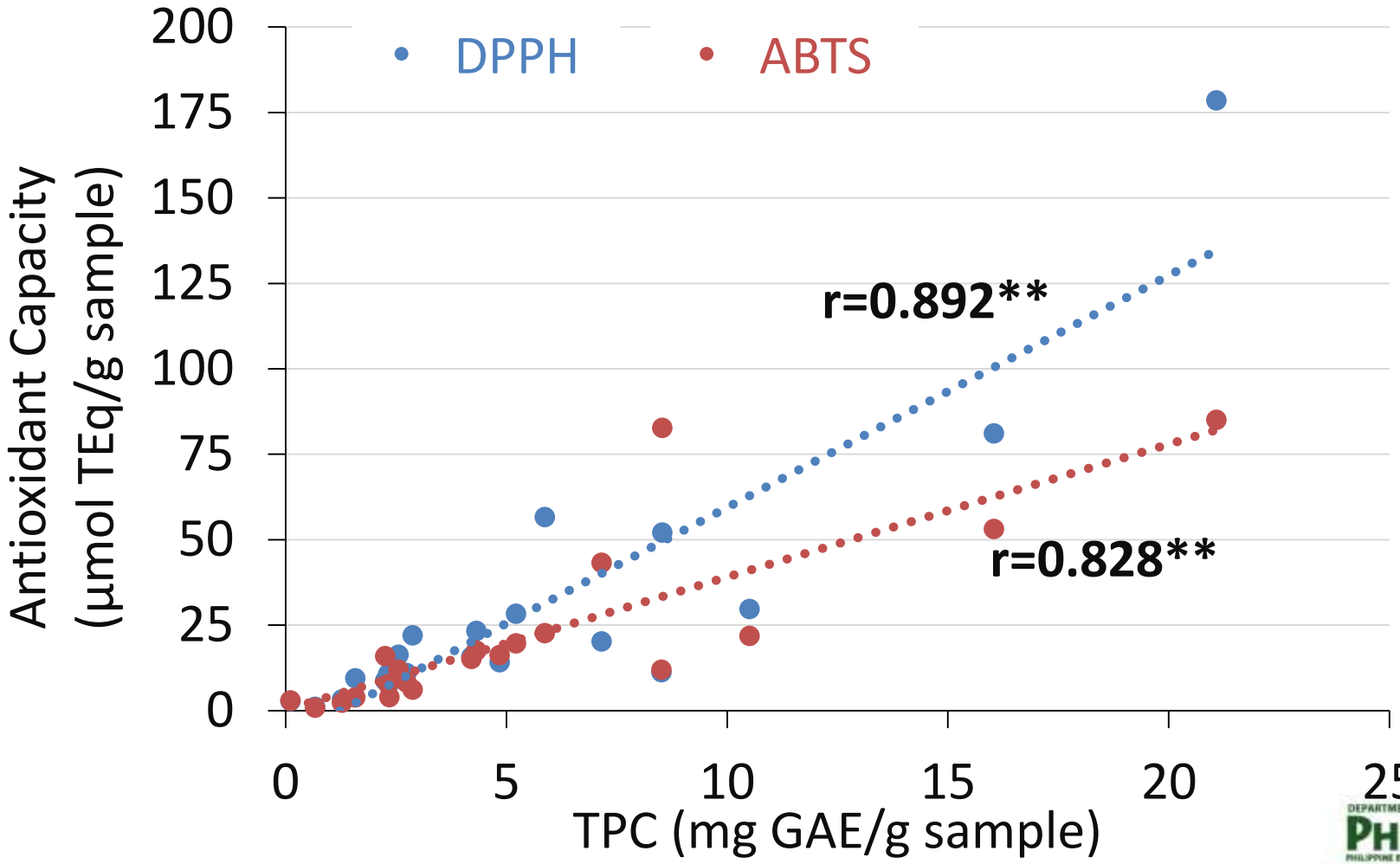
Correlation Analysis

Cooked Samples



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Conclusions

Top Vegetables

Jute

Eggplant

Water Spinach

Green Pepper

Ginger

- Boiling generally reduced the TPC and antioxidant capacities of the vegetables.

Recommendations

- Consumption of raw or minimally heated vegetables is recommended for optimum antioxidant intake.

- TPC is the main contributor for the antioxidant capacities.

Acknowledgement

- Mr. John Michael C. Avila
- Intensified Rice-Based Agri-Biosystems Program
- Future Rice Program
- United Nations University

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Thank you!

John Edward I. Zapater
Rice Chemistry and Food Science Division
Philippine Rice Research Institute
Email: jei.zapater@philrice.gov.ph

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“Everything is marketing.”

Rice-based Product Concepts with Health and Nutritional Value: The Experts' Perspective on Consumer Trends

JFBallesteros, RGARamos, and RVManaois

A need for market research

Our situation

time talent

fund facility

technology developer

Product Development

- Value-adding
- Profitability
- Nutritional benefits

The risk of market failure

38-55%

of new products

FAIL

The gap

fund

time

facility

talent

?

Consumer knowledge

needs

wants

demand

technology developer

customers

The biggest rule

Know Your Market

Objectives

- **Describe experts' perception on health and wellness**
- **Describe experts' perception in the range of products available in the market**
- **Generate rice-based product concepts**

What did we do?

Focus Group Discussion (FGD)

24
experts

13
average years of experience

The Experts

Social entrepreneur, food technologists, managers, nutritionist-dietitians, researchers, chefs, and business owners


7


6


6


2


2


1

1

What we found out?

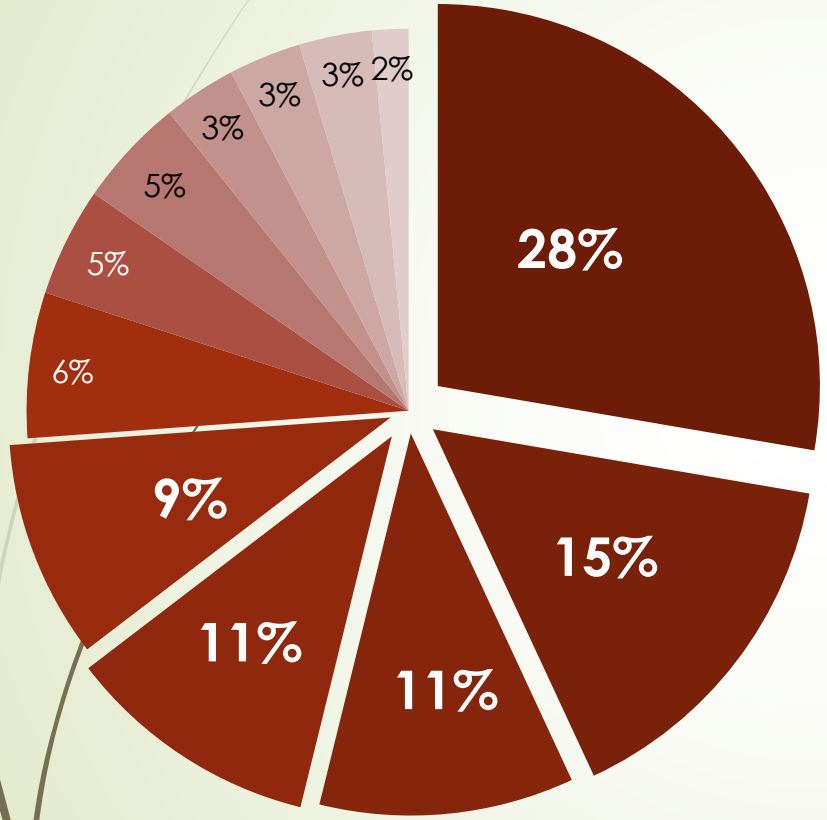
FGD Outputs

Health and wellness

Consumer Trends

Rice-based product concepts considering health and nutrition

Health and Wellness

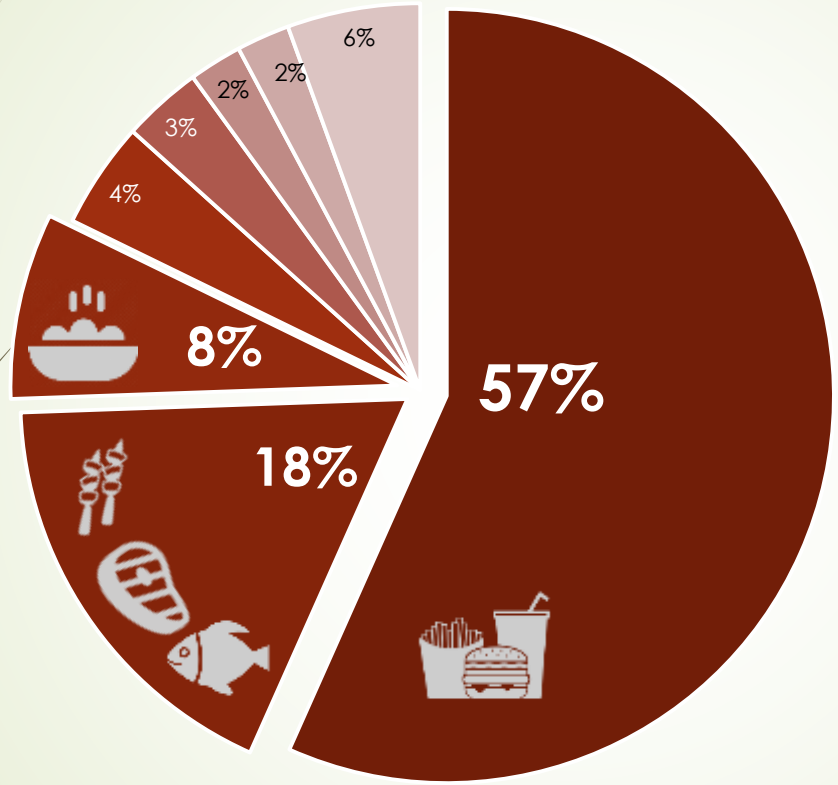


Top 5 thoughts

- food, proper diet and nutrition
- health products
- lifestyle
- views on quality of life
- exercise/physical activity

Consumer Trends

Meals

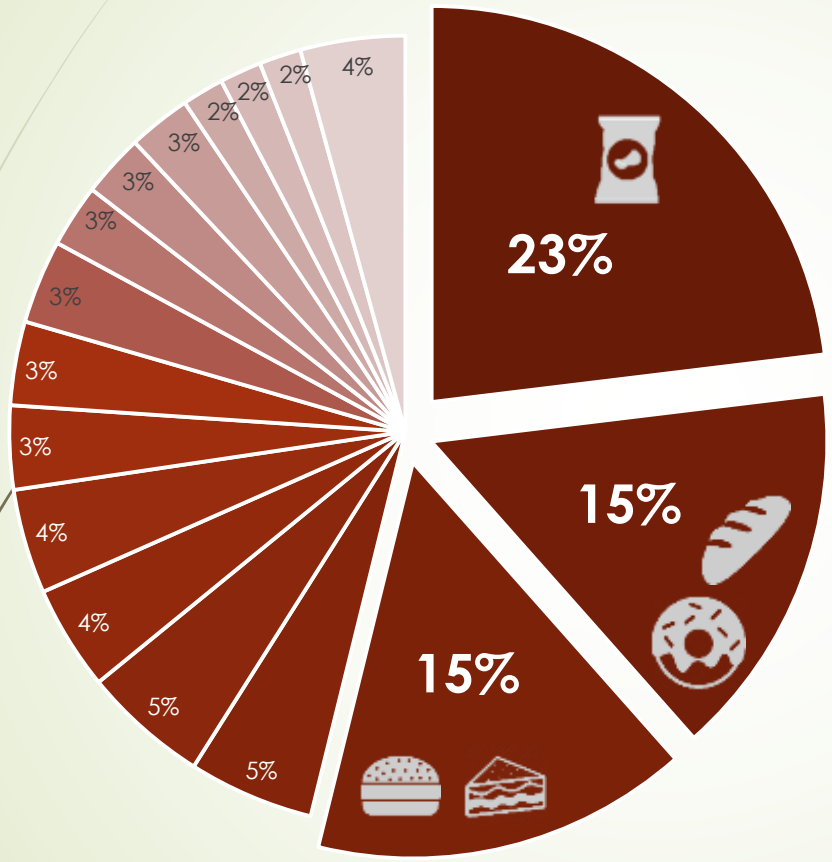


Top 3

- Fast food and restaurant meals
- Home cooked meat/fish
- Instant meals

- Restaurant/Fastfood Meals
- Instant Meals
- Noodles
- Brown Rice
- Home cooked Meat/Fish
- Home cooked vegetable (Chopsuey)
- Nachos/Tacos/Nuggets
- Others

Snacks

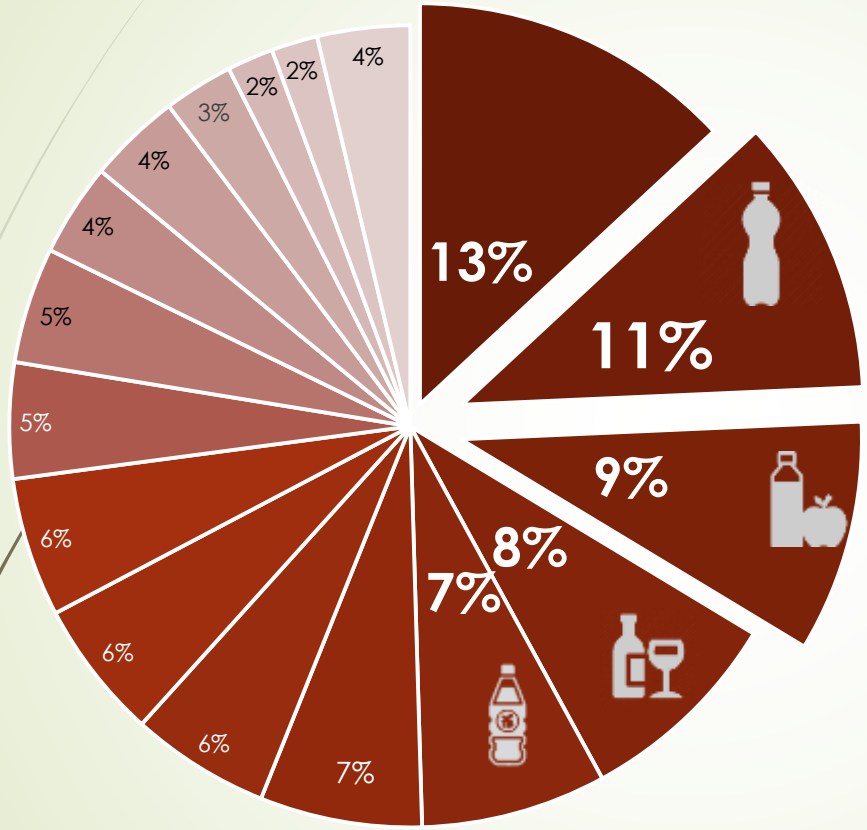


Top 3

- crackers and chips
- breads and doughnuts
- burgers and sandwiches

- Crackers and Chips
- Biscuits and Cookies
- Cakes and hotcakes
- Pizzas
- Rice-based/kakanin
- Others
- Breads and doughnuts
- Non-packed snacks (banana cue/saba/taho)
- Instant Noodles
- Confectionery (chocolates and other sweets)
- Packed Cereals (Oat)
- Burgers and sandwich
- Pasta
- Restaurant Snacks (stew/nalongbao)
- Ice cream
- Yoghurt

Drinks/Beverages

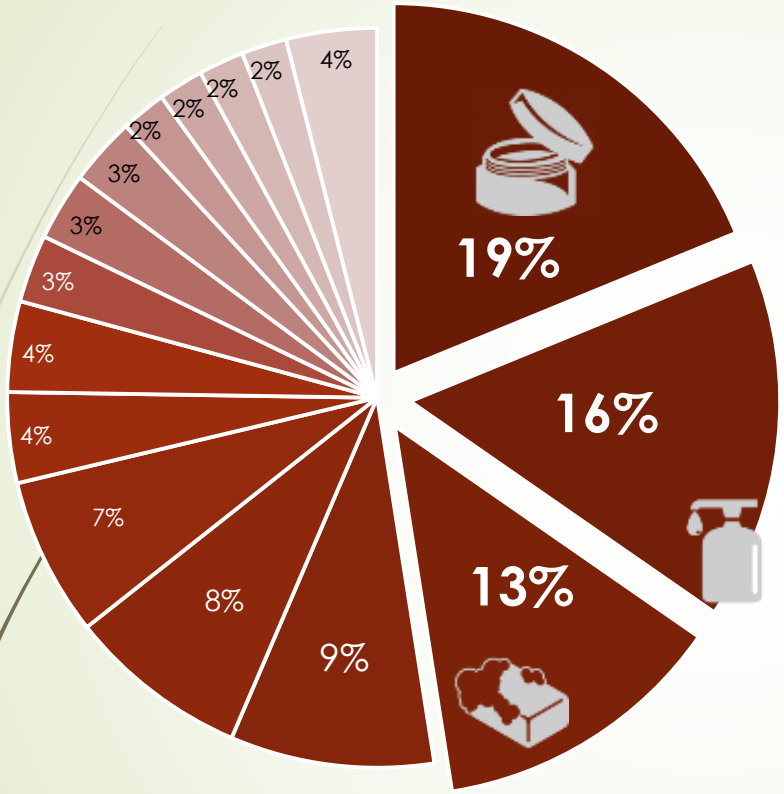


Top 3

- ready-to-drink (RTD) coffee drinks
- Soft drinks
- RTD fruit juices

- RTD Coffee-based drinks
- Alcoholic beverages
- RTD fermented drink (yoghurt)
- RTD milk-based drinks
- Smoothies and Shakes
- Choco-drink
- Soft drinks
- RTD tea drinks
- Energy drinks
- Natural/Fresh drinks (Buko juice)
- Powdered juice
- Others
- RTD Fruit Juice
- Health drinks
- Flavored drinks (Mogu-mogu)
- Bottled water (flavored and unflavored)
- RTD Cereal drink

Hygiene and beauty products

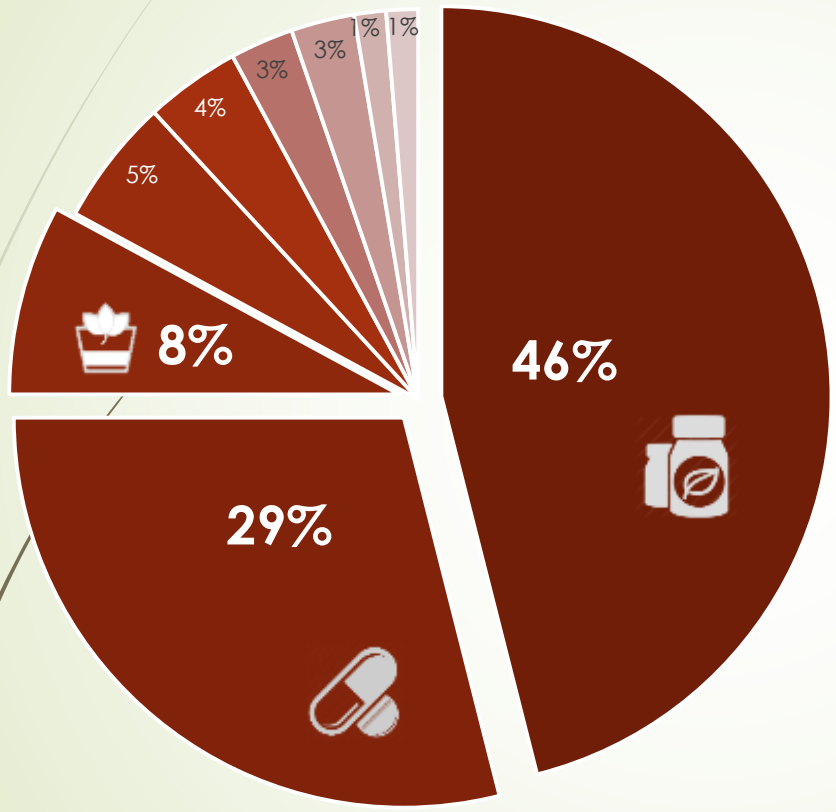


Top 3

- facial care products
- body moisturizers
- soaps and body wash

- Facial care products
- Body Moisturizer
- Soap and body wash
- Toothpaste
- Hair colorant
- Shampoo and Conditioner
- Body Alcohol
- Feminine Wash
- Sanitizer
- Deodorant and Perfume
- Baby Powder
- Mouth wash
- Lip Balm/Lipstick
- Napkin
- Body scrub
- Other

Pharmaceutical/Nutraceutical Products



Top 3

- food supplements
- vitamins/multivitamins
- fortified drinks

Rice-based product concepts

Experts suggest…

- 46% **Flour-based products**
- 29% **Personal care/hygiene products**
- 8% **Drinks/beverages**
- 8% **Special purpose products**
- 7% **Instant products**

Conclusions

Health and wellness is mostly associated with concepts on food, proper diet, and nutrition

Key Consumer Trends

Convenience

Health

Beauty

Future works

product concept screening

consumer research (market survey)

Acknowledgement

- **FGD Participants**

Thank you!

COOKED RICE SPOILAGE AND PRACTICAL WAYS OF RETARDING IT

EH Bandonill, MJC Ablaza, OC Soco, and GG Corpuz

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Current Practice

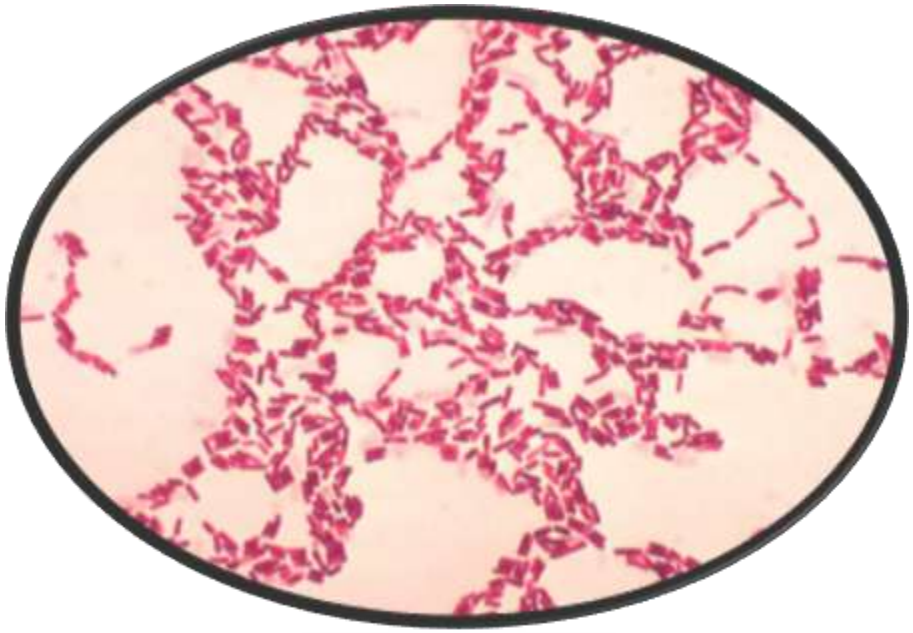
- Cooking rice enough for the whole day
- Keeping cooked rice at ambient temperature
- Consumption of left over rice without reheating

Challenges

- Spoilage of cooked rice
- Improper food handling
- Food-borne outbreaks (Lake et al. 2004)

Challenges

Bacillus cereus – bacterium that survives heat while boiling; capable of growing in cooked rice



Objectives

- Know the possible causes of spoilage in cooked rice
- Discover practical ways of retarding spoilage

Methodology

Amylose content (AC) - gelatinization temperature (GT) combination

Rice Variety	AC-GT	Texture
Koshihikari	Low-Low	Very soft
NSIC Rc160	Low Low	Very Soft
NSIC Rc140	Int-Int	Soft
NSIC Rc142	Int-Int	Soft
NSIC Rc158	Int-Int	Soft
PSB Rc72H	Int-Low	Medium Soft
NSIC340	High-Low	Hard
PSB Rc10	High-Int	Hard

Methodology

- ***Rice samples:*** IR64 and NSIC Rc160
- ***Rice ageing***

  2014 Dry Season (12 mo)

  2014 Wet Season (6 mo)

  2015 Dry Season (2 mo)
- ***Amount of rice cooked per batch***

  300 g vs 500 g
- ***Periodic heating***

  0, 12, 18, 24, 30, 36, 42 h

Methodology

- ***Storage Temperature***

  Room/Ambient (27-29^{o}C; 50-65% RH)

  Refrigerated (4-8^{o}C)

- ***Reheating Practice***

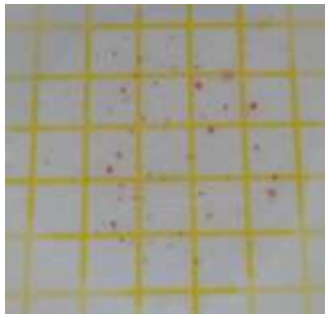
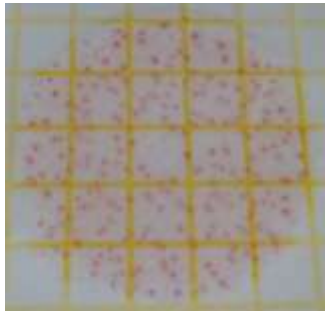
  Unreheated

  Microwave

  Steaming

Methodology

- ***Microbial Load (Total Plate Count, cfu/g)***

- ***Sensory Index (SI)***

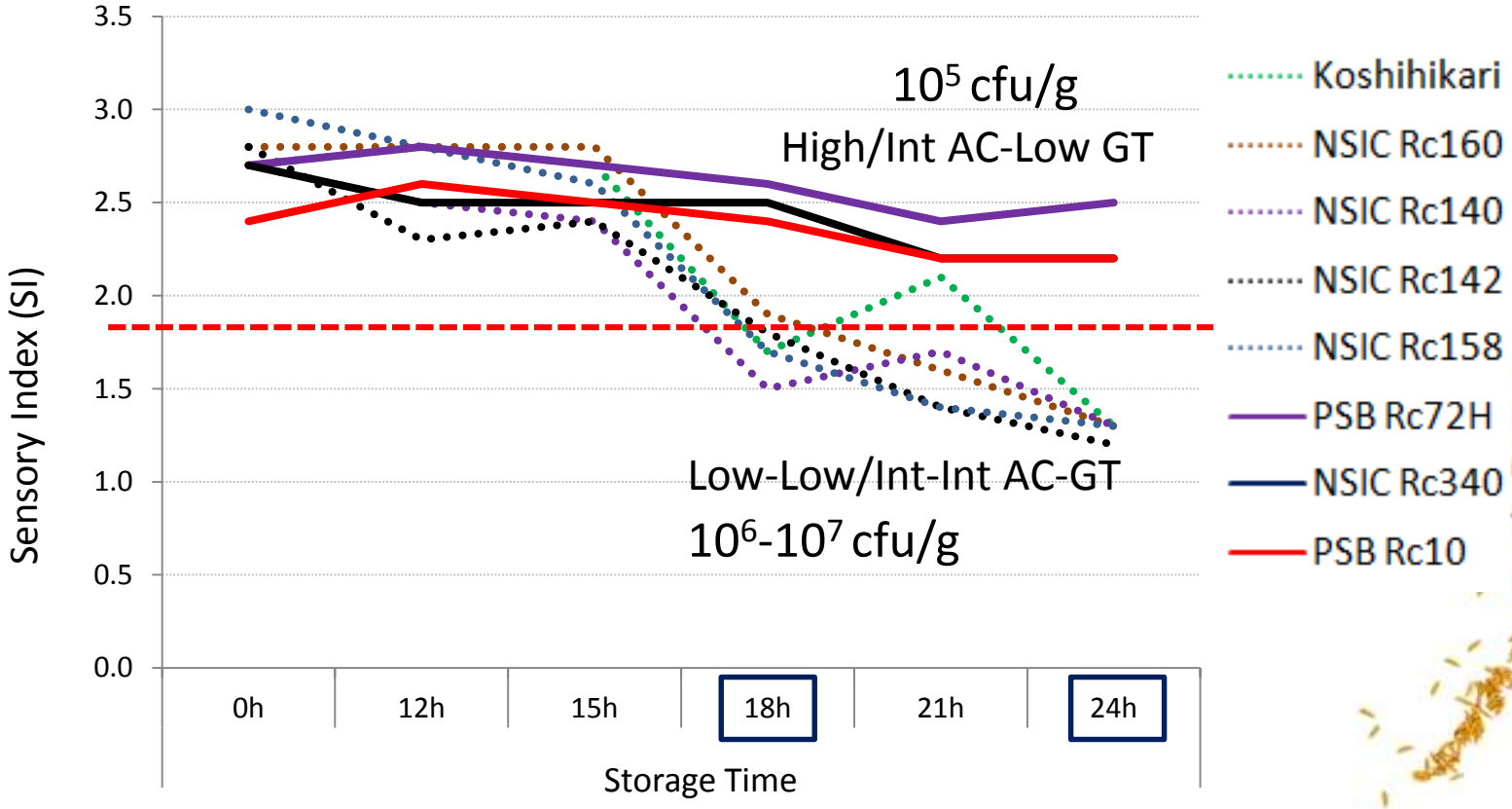
  parameters: color, odor, texture

  scale: 1 *(unacceptable)* to 3 *(acceptable)*

  $$SI = \frac{2.C + 2.O + 1.T}{5}$$

  SI = 1.8 (spoiled)

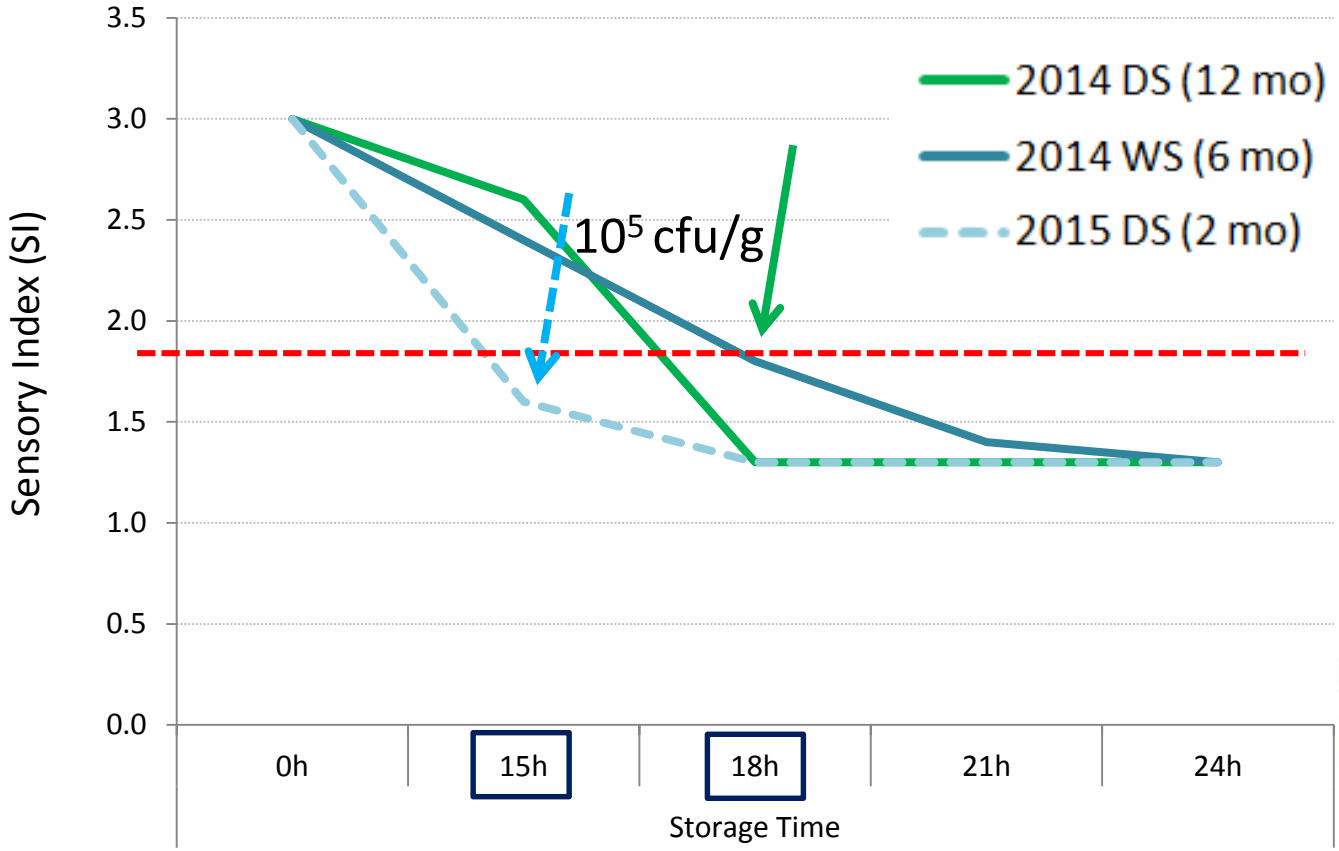
Results: AC-GT Combination



High/Int AC-Low GT rice (medium soft to hard-textured) – higher sensory index (24h); tolerable microbial load

Low-Low to Int-Int AC-GT (very soft to soft-textured) – lower SI (18h); high microbial load; slightly perceptible to perceptible off-odor

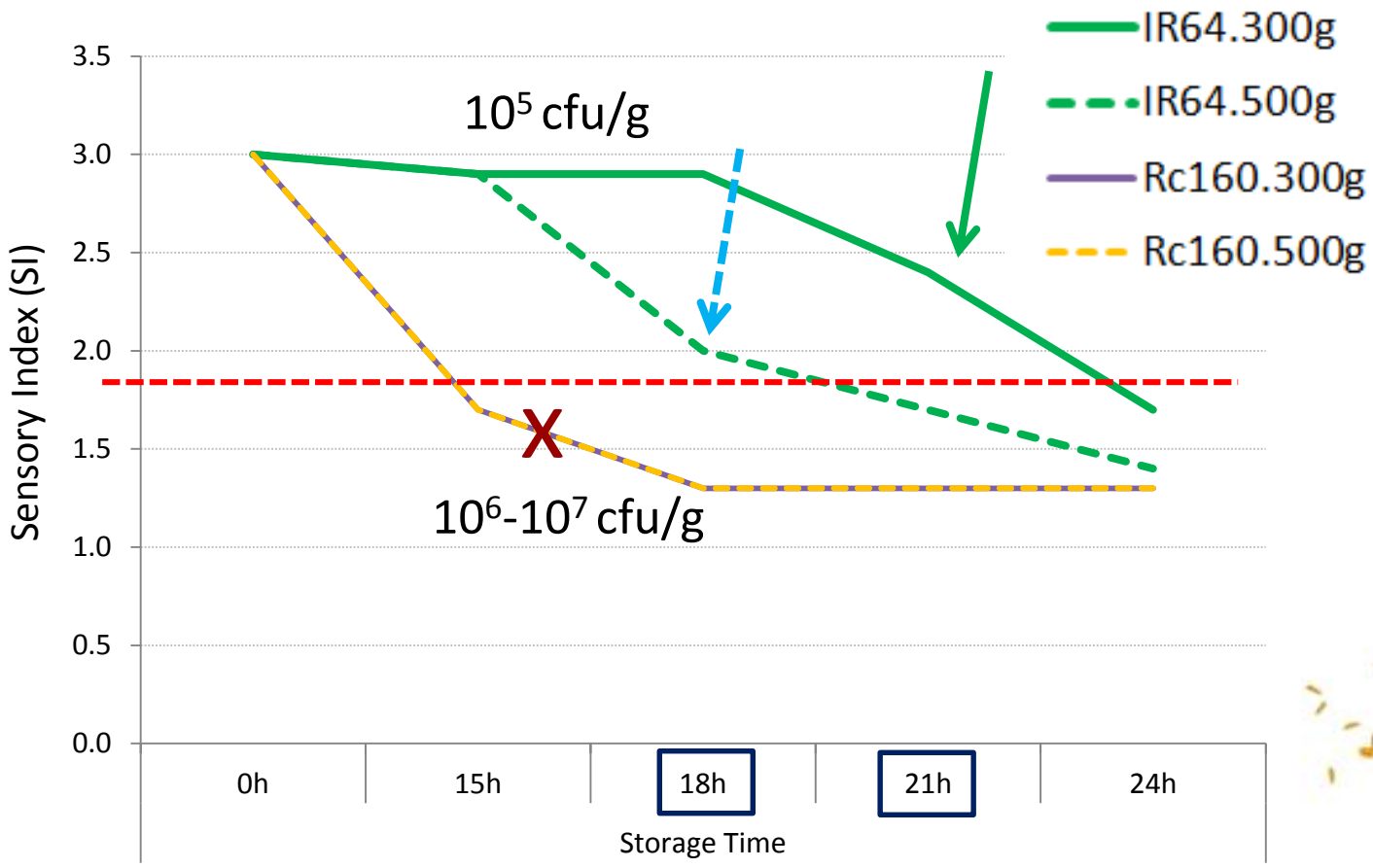
Results: Ageing Period



Aged (2 mo) - spoiled earlier at 15 h

Aged (6 and12 mo) – spoiled later at 18 h

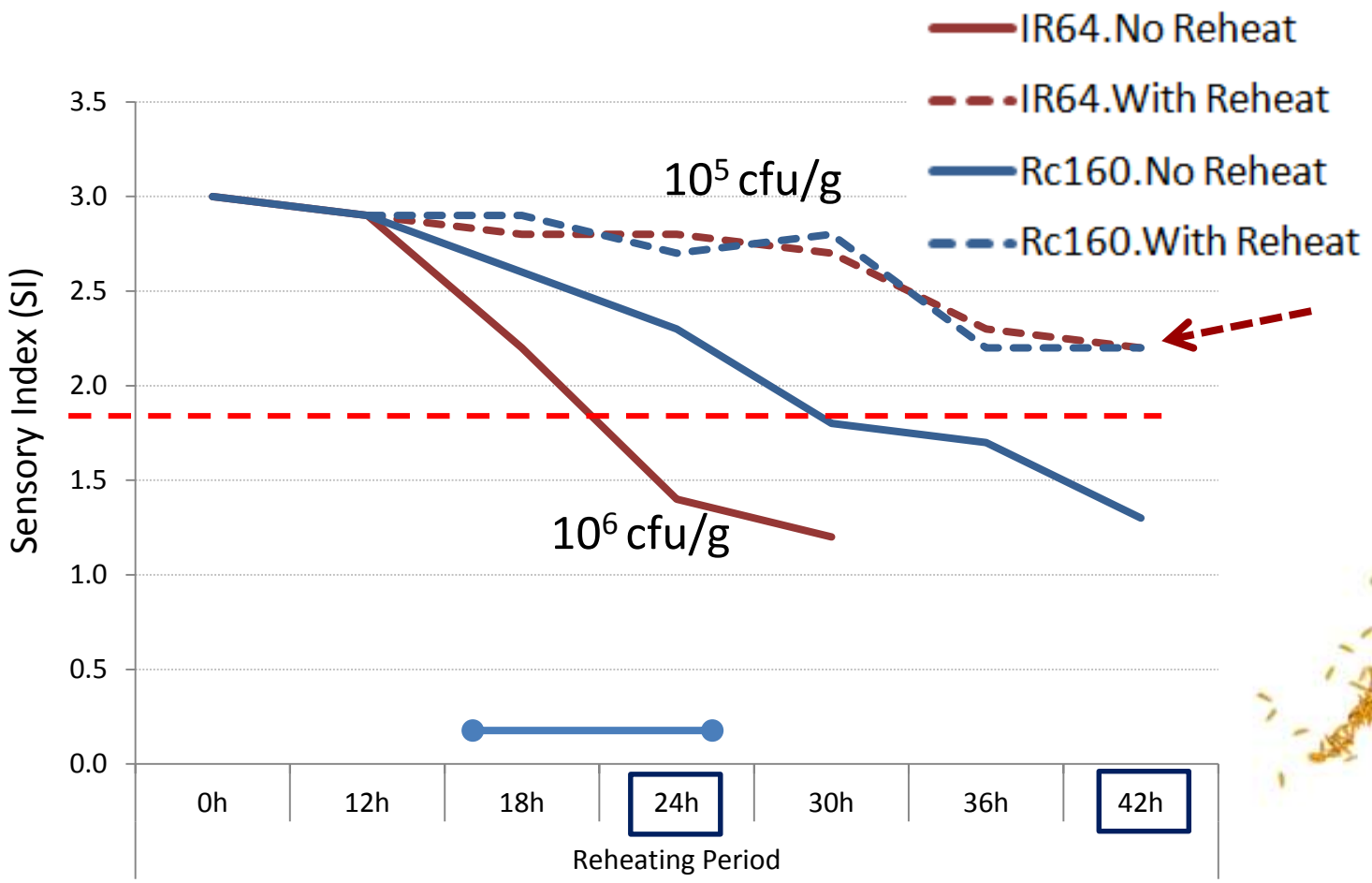
Results: Amount of Rice Cooked Per Batch



IR64: 300 g – remained acceptable up to 21h

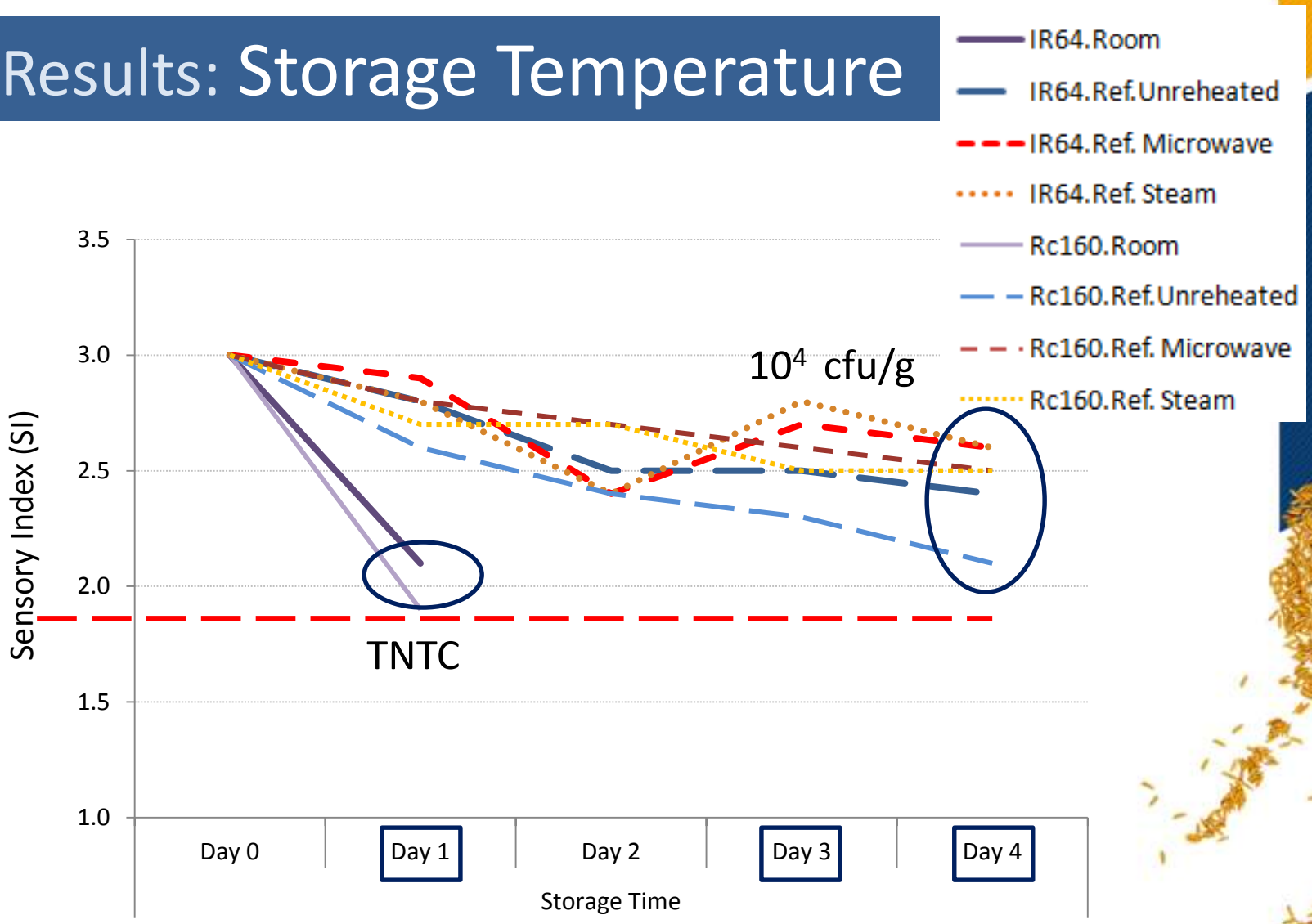
500 g – up to 18h

Results: Periodic Reheating



Reheated (every 6 h) – had extended sensory index up to 42h

Results: Storage Temperature

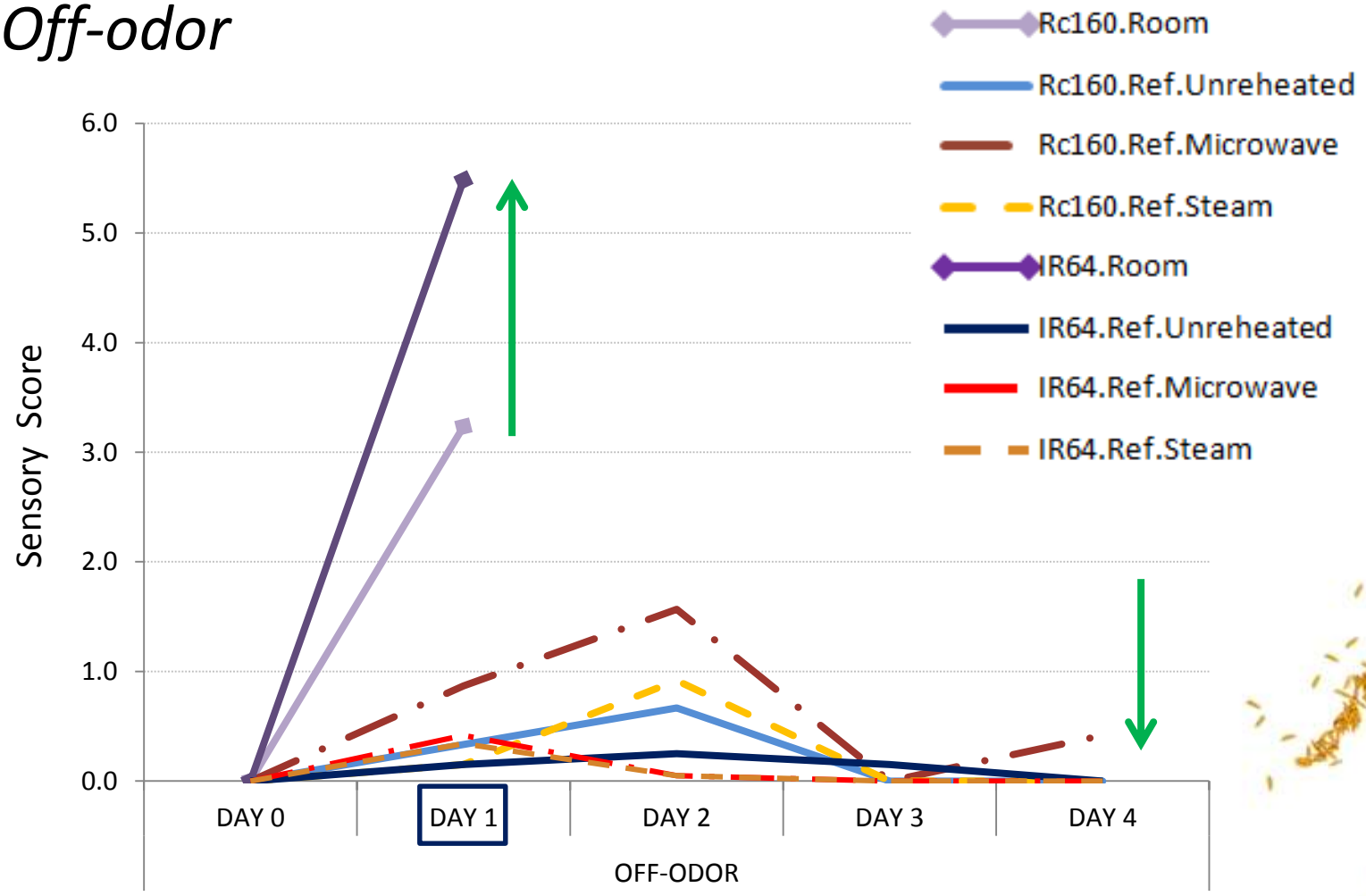


Room temperature – acceptable sensory index up to 1 day

Refrigerated – acceptable SI up to 4 days

Results: Reheating Practice

Off-odor

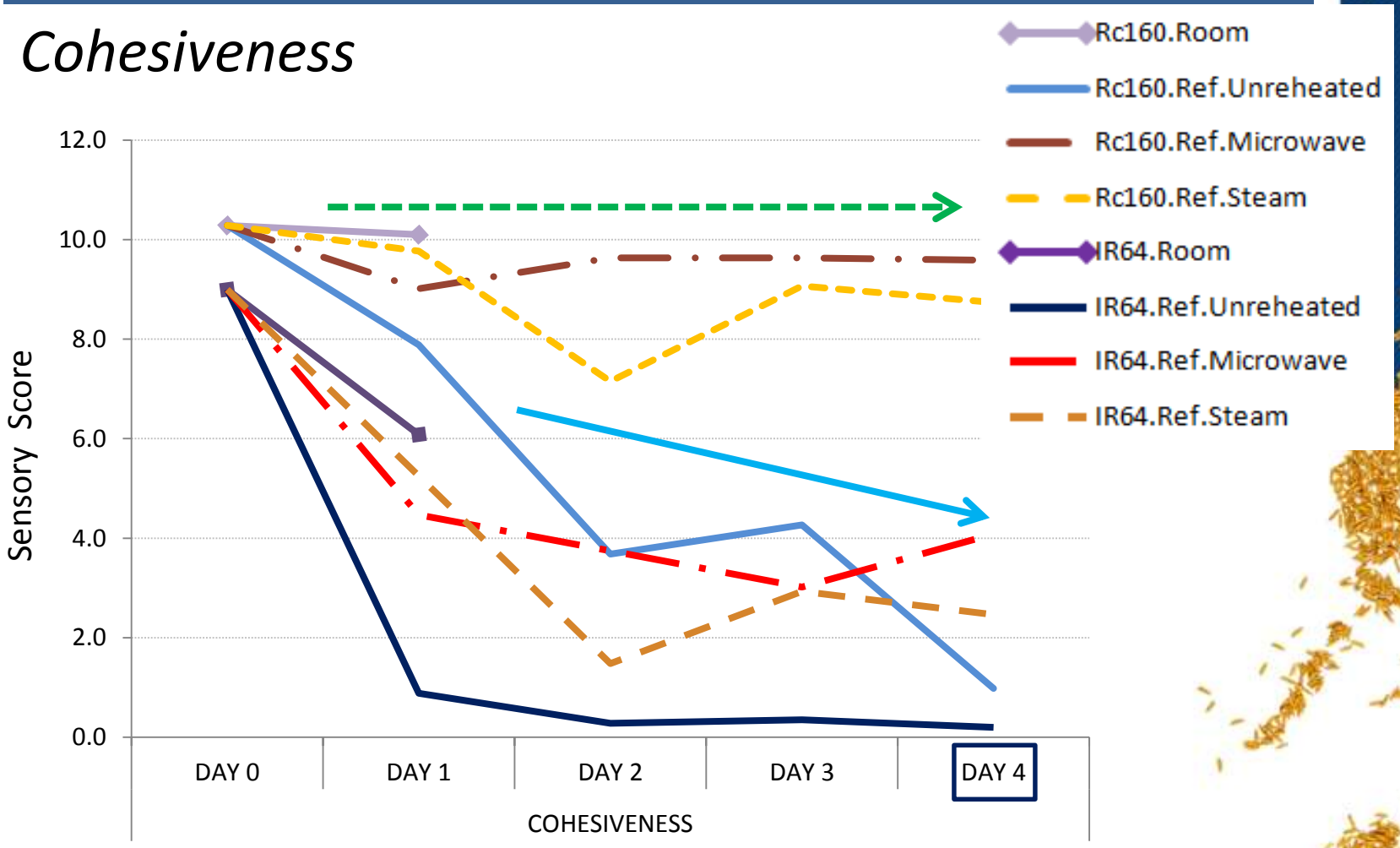


Room – high off-odor score; refrigerated - low to no off-odor

Refrigerated (reheated/unreheated) – low to no off-odor

Results: Reheating Practice

Cohesiveness

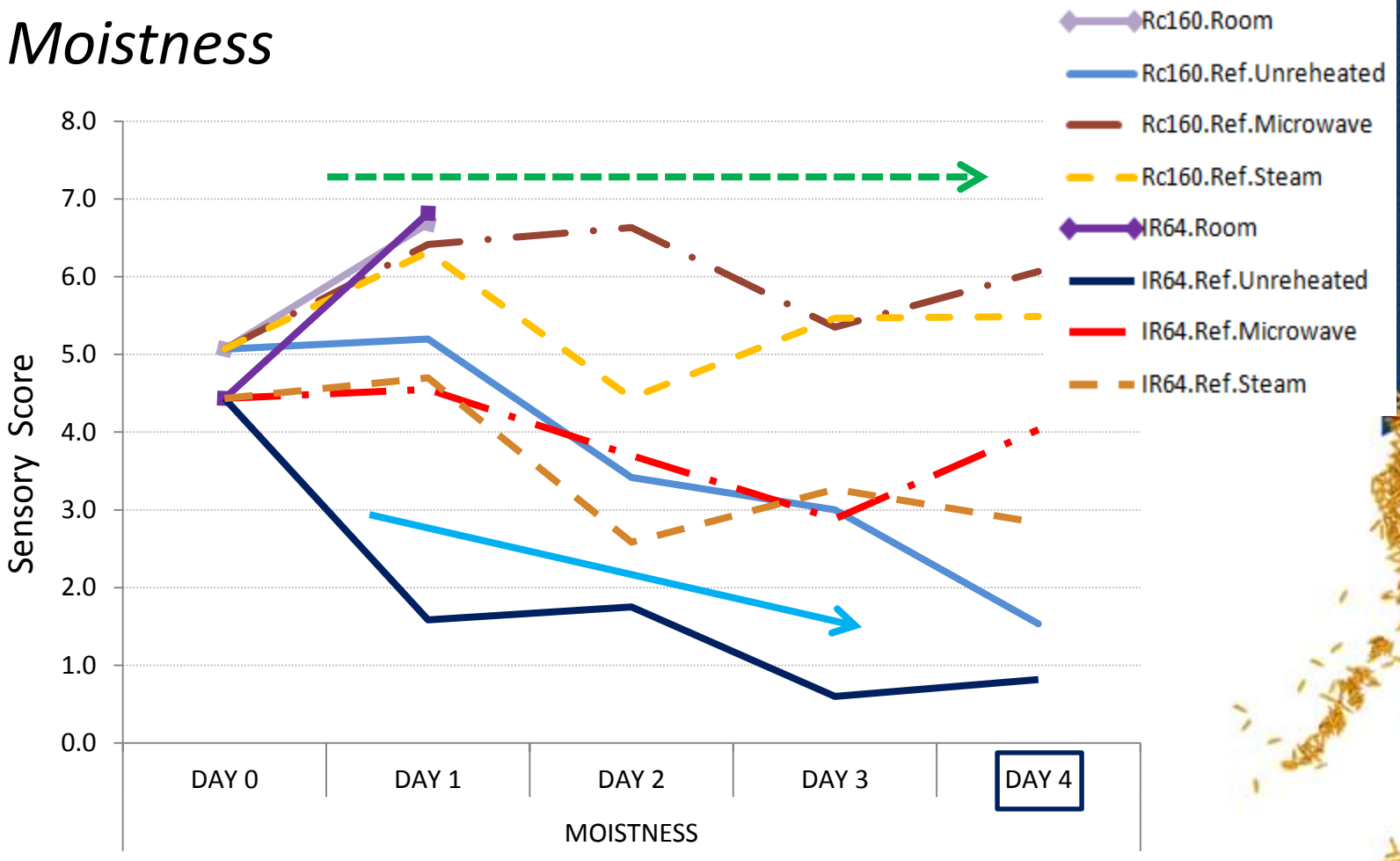


Reheated (Microwave/steaming) - maintained cohesiveness until Day 4

Unreheated – decreasing score for cohesiveness

Results: Reheating Practice

Moistness



Reheated (Microwave/steaming) - maintained moistness until Day 4

Unreheated – decreasing score for moistness

SUMMARY

- Very soft to soft-textured and freshly harvested rice is more prone to spoilage than medium soft to hard-textured and aged sample
- Cooking bigger amounts of rice has more tendency to spoil
- Periodic reheating and storing cooked rice at refrigerated temperature can retard spoilage up to 42h and 4 days, respectively
- Reheating through microwave/steaming makes rice comparable with freshly cooked sample (NSIC Rc160)

RECOMMENDATIONS

- Cook rice in smaller quantities at several times of the day to reduce storage
- After cooking, rice should be kept hot (not lower than 60^{o}C)
- Keep (within 1-2 hours), left over rice inside the refrigerator and not under warm conditions
- Reheat left over rice to as high as 75^{o}C
- If possible, age rice for more than 2 months prior to milling and cooking
- Cook/consume rice with intermediate-low AC-GT types (medium soft)

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SURVEY OF AQUATIC FAUNA USED AS FOOD IN RICE-BASED ECOSYSTEMS IN LUZON

MCV Newingham[1], M Halwart[2], EA Abella[3], EM Vera Cruz[3] and TA Abella[3]
[1]Philippine Rice Research Institute
[2] Food and Agriculture Organization of the United Nations
[3] Central Luzon State University

mcv.newingham@philrice.gov.ph
+639228699672/+639985108560

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Rationale:

- Rice-based ecosystems provide habitat for a wide range of aquatic organisms used as food
- Contribute a large share of the animal protein and other nutrient intake of poor households in Southeast Asia
- Importance of freshwater aquatic resources in the food security of rural households is generally underestimated and undervalued

- There is an observed rapid decline in the populations of edible aquatic fauna
- There is a need to intervene since some species may have been lost before a full documentation could be done
- No baseline data or country stats re: status of freshwater aquatic fauna used as food

Objectives

- Documentation and identification of aquatic fauna and the strategies used to acquire them
- Identify species that have been lost or have been introduced in the community
- Identify perceived threats to the ecosystem and check for remedial actions done locally to help sustain the food resource.

Sampling locations

- Sites: Central Luzon (4) and Ifugao (1)
- Time frame: September 2013 – December 2014

Strategies to collect data

- Participatory rural appraisal
- Confirmatory survey
- Identification of Species

Q: *What is still available in the ricefields of Luzon?*

Pre-survey results:

- A total of 45 species were listed:
  - 25 fishes
  - 9 mollusks
  - 5 crustaceans
  - 1 insect
  - 1 amphibian
  - 4 reptiles

Confirmatory survey results

- 23/25 species of fishes documented
  - 7/8 indigenous fish species found

Suswe or susay - Dermogenys pusilla

Lukaok or Martiniko - Anabas testudineus

Bulig or Dalag – Channa striata

Biya - Glossogobius giuris

Ayungin - Leiopotherapon plumbeus

Kanduli - Arius sp.

Hitong native - Clarias macrocephalus

- 16/17 introduced fish species found

Talandi or Burasi - Carassius gibelio

Karpa or Burasi - Cyprinus carpio

Rohu - Labeo rohita

Buan-buan or Burasi - Carassius carassius auratus

Maya-mayang tabang - Hypophthalmichthys molitrix

Dojo fish - Misgurnus anguillicaudatus

Bid-bid - Elops sp.

Tilapia - Oreochromis niloticus

Tilapiang Tato - Vieja synspilum

Guraming itim - Trichogaster pectoralis

Guraming tuldok - Trichogaster tricopterus

Guraming puti - Trichogaster sp.

Hitong pula - Clarias batrachus

Hitong Taiwan - Clarias gariepinus

Janitor fish - *Pterygoplichthys sp.*

Kiwet - Monopterus albus

- 5 species of mollusks (4 listed species not accounted)

Tulya - Corbicula fluminea

Kuhol - Pila conica

Golden Kuhol - Pomacea canaliculata

Susong bato - Angulyagra oxytropis

Susong pilipit or Agurong - Melanoides sp.

- 5 species of crustaceans

Hipong malaki - Macrobrachium idella

Giant ulang - Macrobrachium rosenbergii

Kuros - Metapenaeus ensis

Australian ulang - Cheraxquadricarinatus

Talangkang bukid - Paratelphusa hydrodromus

- 1 amphibian; 1 reptile (3 listed species not documented)

Palakang bukid - Fejervarya limnocharis

Pagong or Antipa - Cuora amboinensis

Sawa – Python reticulatus

Kobra / Ulupong – Naja philippinensis

Bayawak – Varanus salvator

- 0 species of insects

Alukap – Lethocerus indicus

WANTED!!!

Name: Alukap aka Giant Water Beetle

Alias: Obus

Length: approx. 2.5-3.0 inches

Whereabouts: Unknown

Latest Status: Missing in Action;

Probably Endangered or extinct in Central Luzon and Ifugao?

Manual gathering methods used

Hand gathering (*manu-mano*)

Electrofishing (*aparato*)

Rod or pole fishing (*bingwit*)

Spear gun (*baril o pana*)

Scoop net (*salok*)

Plunge basket (*salakab*)

Manual gathering methods used

Sieve tray (*yakayakan*)

Triangular frame sieve (*sagat*)

Rounded cast net (*dala*)

Small drag net (*lambat*)

Large drag net (*pukot*)

Installed traps

Twig trap (*palamag*)

Bottle-shaped basket traps (*bubo*)

Screen trap (*pangkolong*)

Large rectangular framed net trap (*skylab*)

Installed traps

Mini framed net trap (*mini-skylab*)

Stationary net trap (*pante*)

Stationary funnel net trap (*bocatot*)

Determining species availability

Timeline (community perceptions)

Versus

Results of the confirmatory survey

Scoring:

4 = Abundant

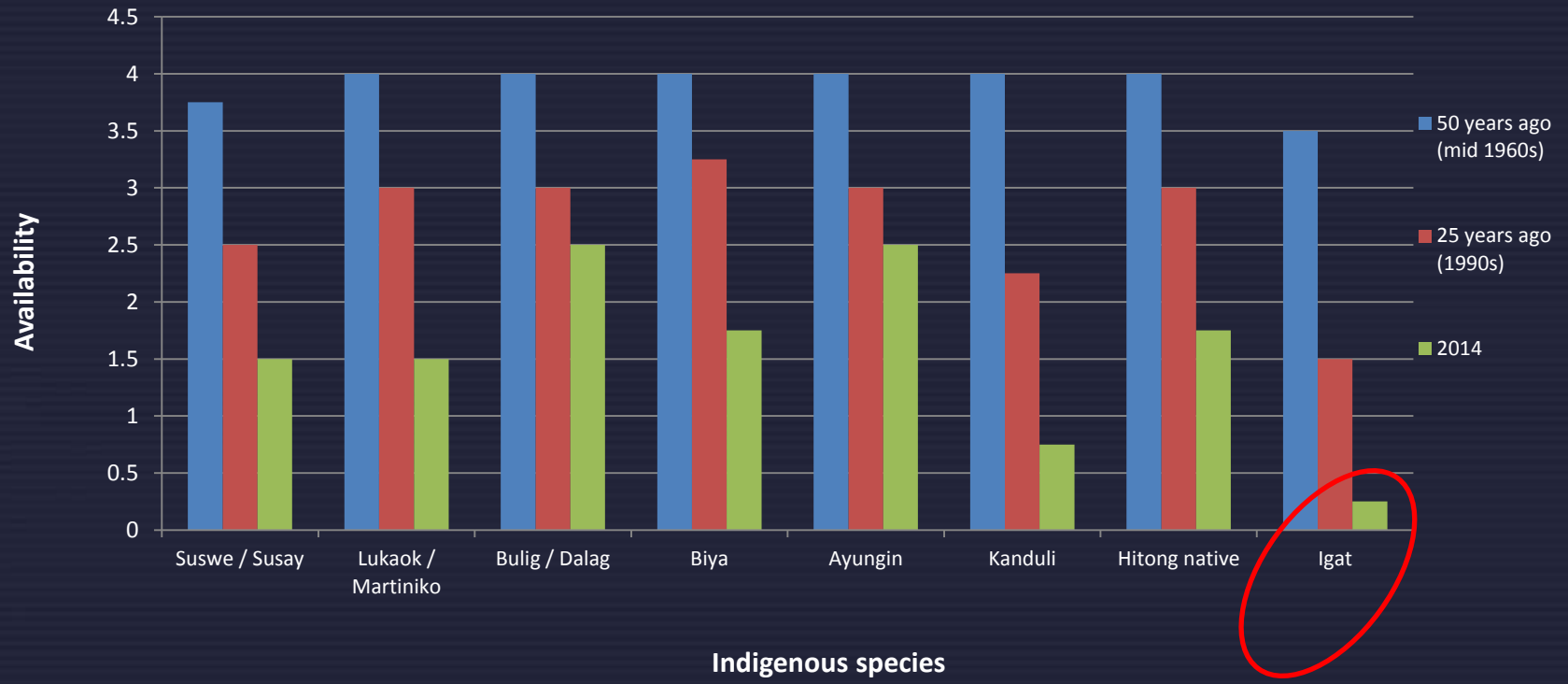
3 = Many

2 = Few

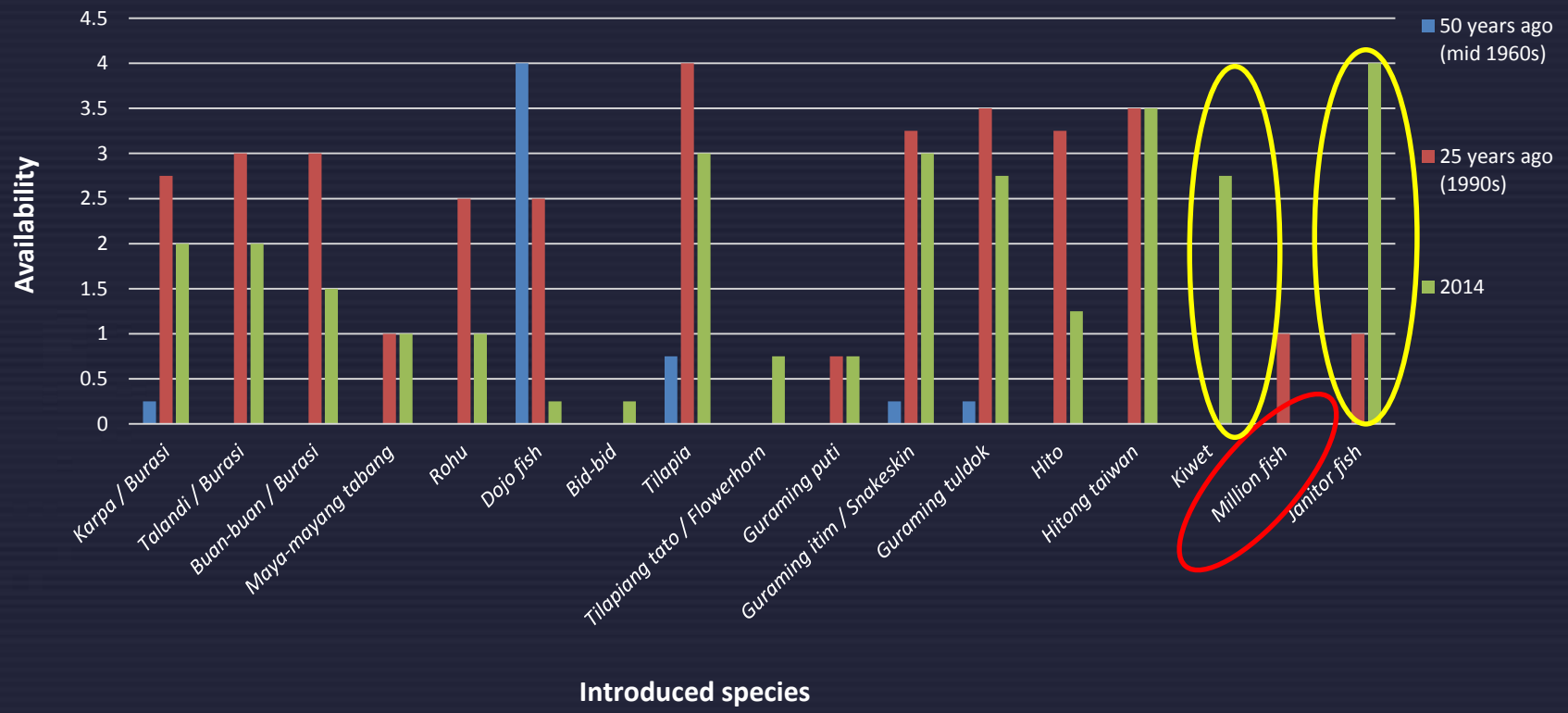
1 = Rare

0 = No sighting / Endangered / Extinct?

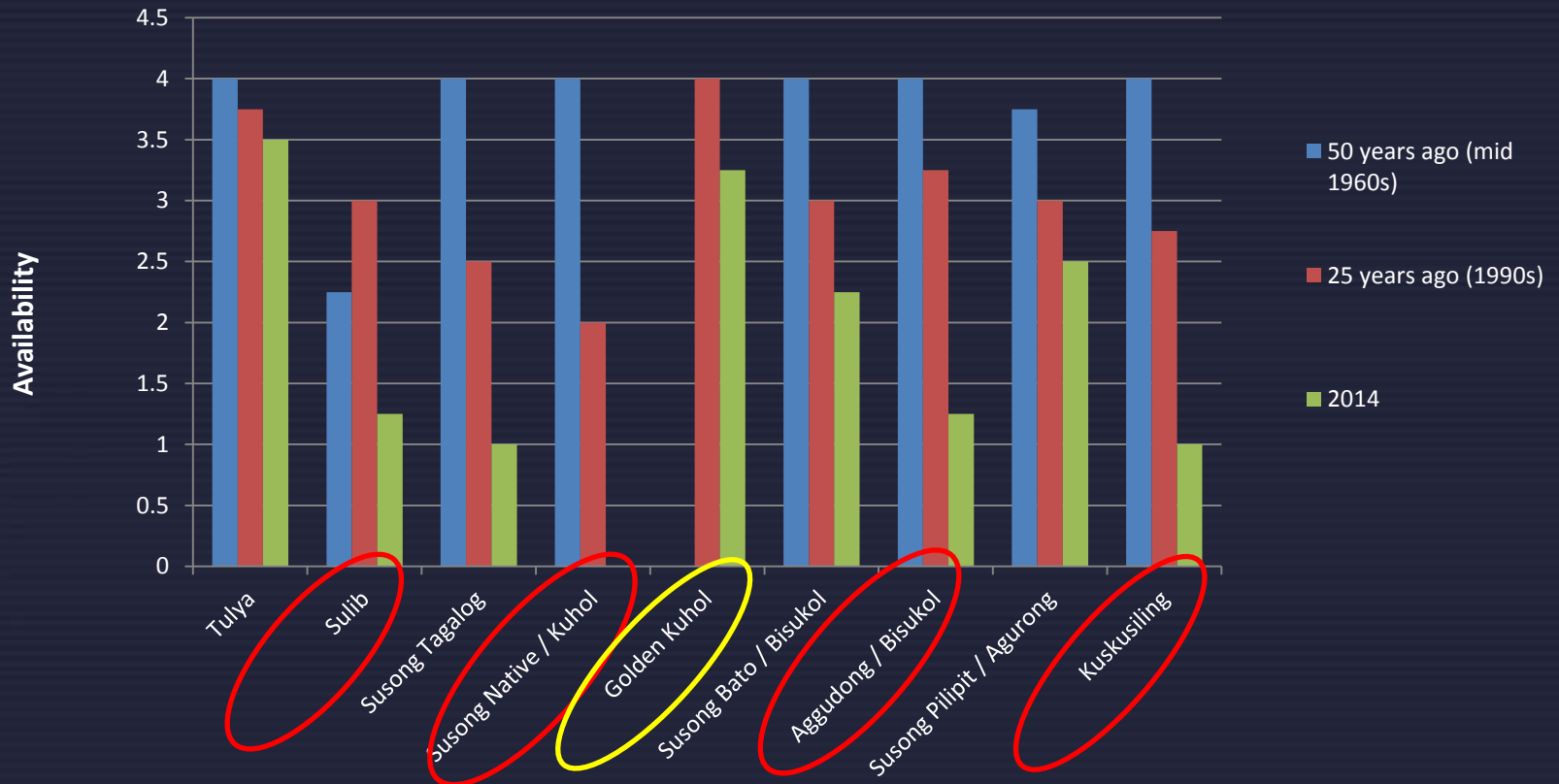
Indigenous fish species availability as perceived by PRA participants



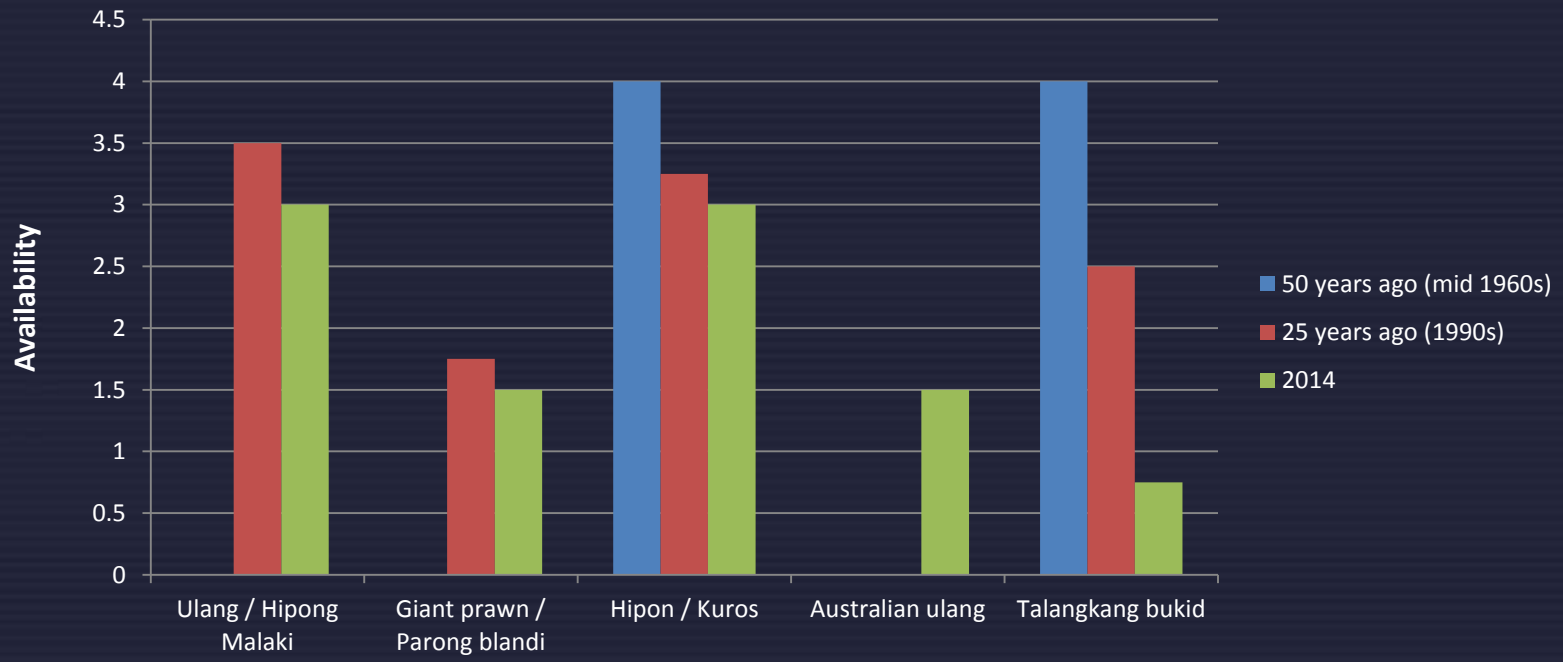
Introduced fish species availability as perceived by PRA participants



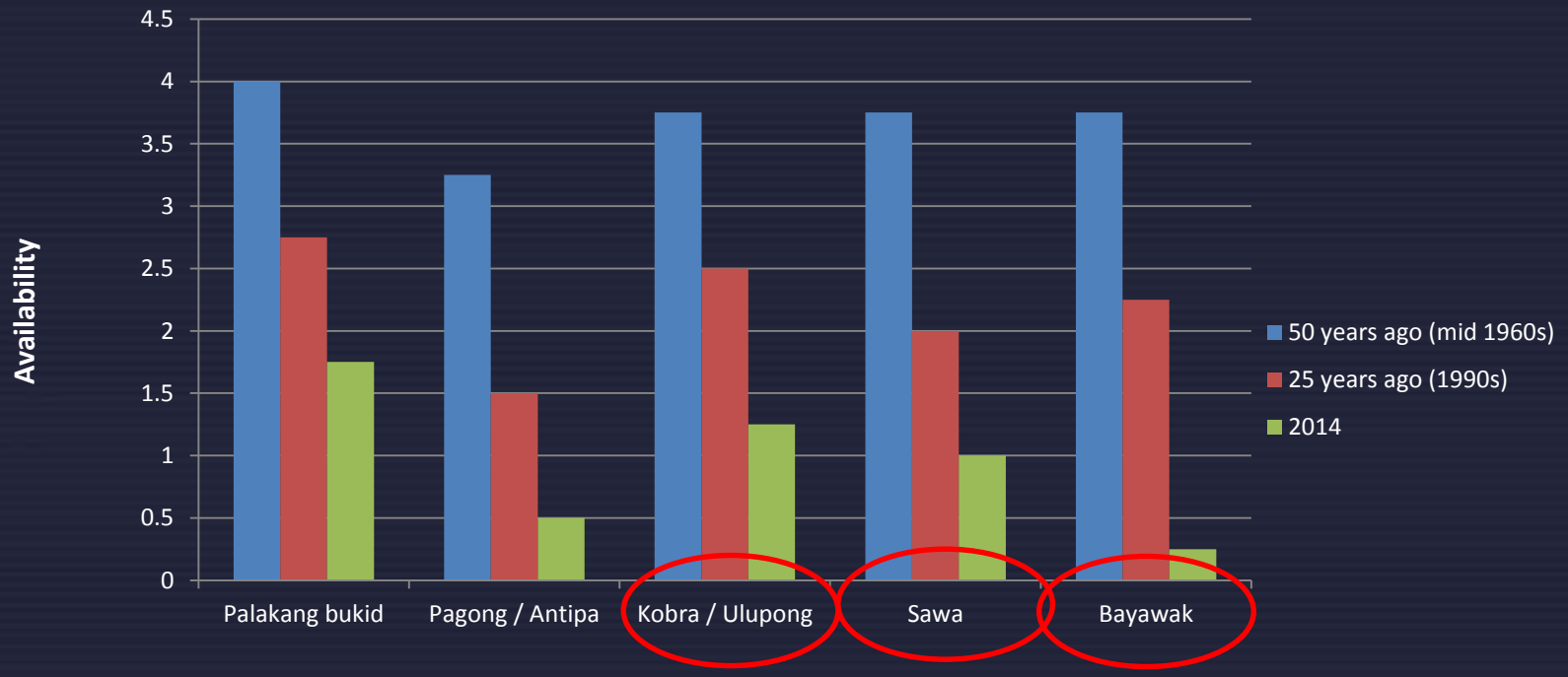
Ricefield-based mollusks availability as perceived by PRA participants



Ricefield-based crustacean species availability in as perceived by PRA participants



Ricefield-based amphibian and reptilian species availability as perceived by PRA participants



Threats as perceived by local residents

Land and water pollution

Land conversion to other activities

Water supply availability

Biological pollution due to alien/introduced species

Conclusions

- Identified 45 aquatic fauna as food resource; 36 existing
- Documented 18 methods (11 manual and 7 installed) of acquiring food resource.
  - Electrofishing - most popular, most widely used and most devastating
- Documented 21 introduced; 9 “unaccounted” species
- Identified 4 threats as perceived by locals
  - Climate change was not seen as threat
  - Remediation or control measures are almost non-existent at barrio level
  - When asked to device or formulate control measures that may be implemented, majority of the respondents said that the government should do something about it.

Endangered or extinct?

"Ine" (2008-2013)

Recommendations

- To address sustainability of aquatic food resources:
  - Nation-wide campaign to increase awareness of the dynamics in the ricefield ecosystem starting at barangay level;
  - Further studies in other locations to determine if the same threats are experienced and affecting the survival of these edible species;
  - Development of farming practices that promote sustainability of this species;
  - Total ban of electro-fishing
  - Inter-agency collaborations to help conserve existing species.

Recommendations

- To address threats:
  - Implementation of
    - proper waste disposal policies;
    - more stringent policies in handling inorganic chemicals and a campaign for local awareness of the hazards of inorganic chemical run-off;
    - stricter land conversion policies;
    - stricter policies in exotic species introduction and management;
  - Awareness campaign about climate change issues in the barrios

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Salamat po!!!

FISH BE WITH YOU &
HAVE A RICE DAY!!!

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