Citri-Fi® Benefits in Meat Products Webinar

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Webinar Topics

- Trends
- Brine Injection:
  - Synergistic Yield Improvement
  - Phosphate Replacement
  - Plated Rosemary
- Marinades
- Comminuted Meats
- Hot dogs / Frankfurters
- Gyros
- Vegan burgers
- Product Examples
- Innovation Contest

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Market Trends

- Clean label yield and texture improvement
  - Phosphate replacement in processed meats
- Fat reduction
  - Sausages
  - Fried coating systems
- Sodium reduction
- Extended meat products
  - Cost reduction
  - Healthier versions
  - Retorted sausages
- Frozen meats
- RTE meats and poultry growing
- Vegan/vegetarian foods

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Meat Segment

- Brine Injection:
  - Yield Improvement
  - Phosphate Replacement
  - Plated Rosemary
- Marinades
- Meat Extension: Ground Meat & Hot Dogs
- Gyros
- Vegan burgers

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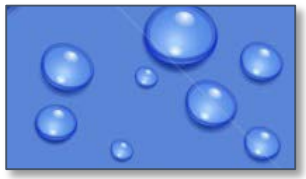
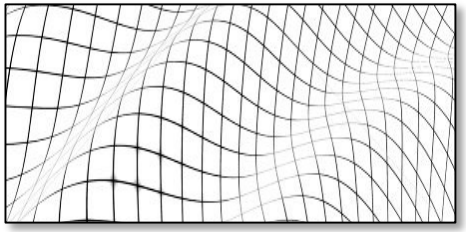
Unique Functionality of Citri-Fi

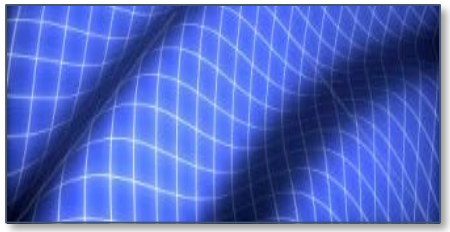
Soluble Fiber – attracts water, adheres and provides viscosity.



Insoluble Fiber – provides a structure to hold the water indefinitely.

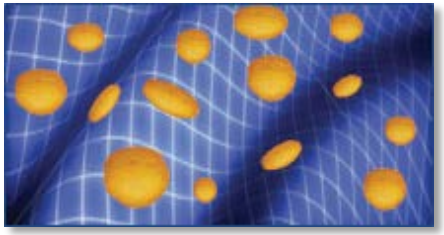


Insoluble Fiber Structure



Fiber Structure Holding Water

Protein – provides fat and oil binding to stabilize emulsions.



	Citri-Fi 100 (Citrus Fiber)	Citri-Fi 125 (Dried Citrus Fiber)
Soluble Fiber	34.7%	41.9%
Insoluble Fiber	41.4%	39.1%
Total Fiber	**76.1%**	**81.1%**
Protein	7.0%	5.1%

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Meat Products

Citri-Fi Products:

- Citri-Fi® 100
- Citri-Fi® 100FG
- Citri-Fi® 125FG
- Citri-Fi® 200
- Citri-Fi® 200FG

Depending on the current moisture loss/purge in the formulation, additional water can be added

Food Application	Citri-Fi Products	Usage Levels	Suggested Usage
Beef Patties	125FG, 200FG, 100FG	0.25% -0.75%	Dry/directly into meat
Canned Tuna	100FG, 200FG	0.25% -1.00%	Dry/Fat
Hot Dogs	100FG, 200FG, 100, 200	0.25% - 0.50%	Dry/directly into meat
Italian Sausage	100FG, 200FG, 100, 200	0.25% -1.00%	Dry/directly into meat
Meatballs	125FG, 100FG, 200FG, 100, 200	0.25% -1.00%	Dry/directly into meat
Meat Fillings	125FG, 200, 200FG, 100, 100FG	0.25% -1.00%	Dry/directly into meat
Pet Food (canned)	100FG, 200FG, 100, 200	0.25% -0.75%	Dry/Fat/Directly into meat
Sausage	100, 200, 100FG, 200FG	0.25% -1.00%	Dry/directly into meat
Kebab/Gyros	100	0.25% -1.00%	Dry/directly into meat
Poultry, injected	100M40	0.25%- 0.50%	Dry
Ham, injected	100M40	0.25%-0.50%	Dry
Marinades for Tumbling	300FG, 200FG, 100M20, 100M40, 100FG	0.25% -0.75%	Dry/Fat

Brine Injection: Yield benefit with Phosphates

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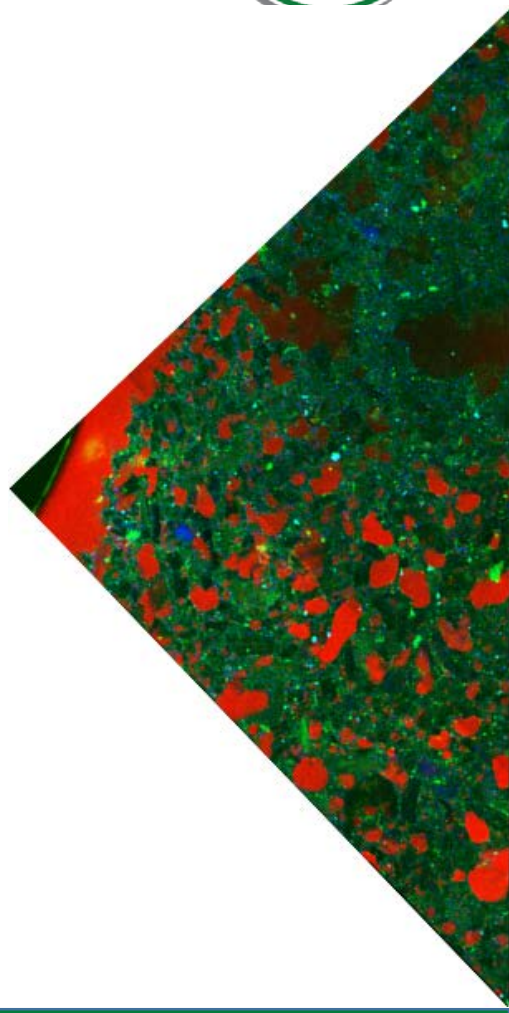
Citri-Fi's Binding Mechanisms

- Strong water binder
  - Macerated cell walls from citrus fruit
  - Pectin interwoven within cellulose fibers
- Highly functional
  - Citrus fibers are translucent and melt away into the natural fibers of meat, less chance of gel pockets
  - No heat step needed for functionality.
  - Emulsifies fat naturally
- Stability
  - Effective in a wide range of pH
  - Pectin locks in water
  - Can endure high heat over long times without breaking down
- High shear hydration increases performance



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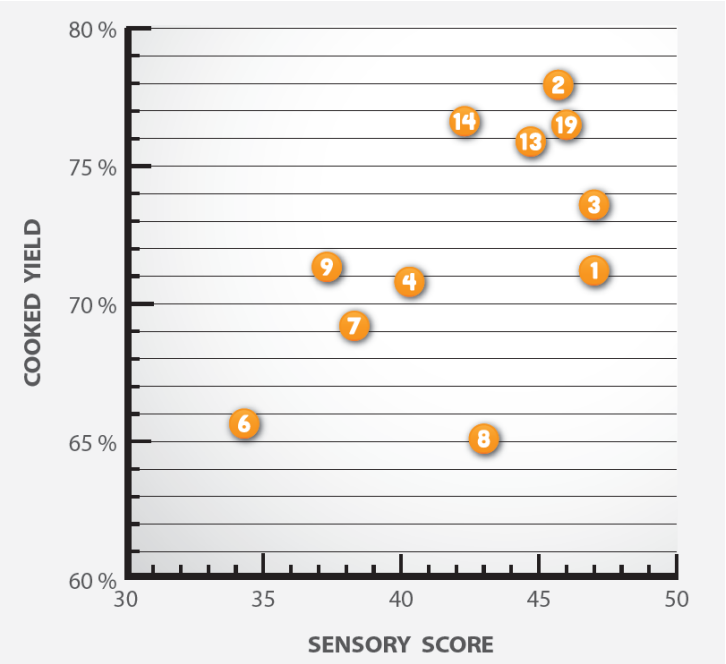
Phosphate Yield Extension

Top Sensory and Yield Performer was combination of Phosphate 0.4% and CF 100M40 0.4%

Trial Formulas

Trial #	Ingredient 1	Level	Ingredient 2	Level
1	Sodium Phosphate	0.30%	None	--
2	Citri-Fi 100M20	0.40%	Phosphate	0.30%
3	Citri-Fi 100M40	0.40%	Phosphate	0.30%
4	Citri-Fi 100M40	0.40%	None	--
6	Turkey Protein	0.15%	None	--
7	Turkey Protein	0.15%	Citri-Fi 100M40	0.40%
8	Pork Protein	0.25%	None	--
9	Pork Protein	0.25%	Citri-Fi 100M40	0.40%
13	Citri-Fi 100M40	0.40%	Potato Starch	0.50%
14	Citri-Fi 100M40	0.40%	Rice Starch	0.50%
19	Citri-Fi 100M40	0.40%	Kappa Carrageenan	0.20%



**2015 University Testing supported the result that CF 100M40 and Sodium Phosphate in combination out-perform Sodium Phosphate alone.

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**University of Wisconsin-Madison

Yield Extension Results

- Citri-Fi combined with refined Kappa Carrageenan and/or rice starch performed as well, if not better, than the phosphate brines tested in up to 30% injection rate in poultry.
- Citri-Fi on top of a phosphate brine system performed at highest yield potential and in the reduction of purge.
- Citri-Fi Usage Level in brines for injections are 0.3-0.5% of the finished product.
- Recommended product Citri-Fi® 100M40.
- Citri-Fi should be pre-mixed with other dry ingredients, then the mix should be added slowly into the brine.
- Keep the brine constantly agitated.
- Expected yield increase 4-6%.

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Brine Injections: Phosphate Replacement: using Citri-Fi with other hydrocolloids

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Phosphate Challenges

- Labeling
  - Concern about health issues
- Low Solubility & Low Dispersion
  - Typically need to use phosphate blends to improve the solubility
- Sodium Reduction
  - Potassium phosphates used in meat products to qualify for low-sodium claims, however, potassium phosphates have low solubility
- Approvals
  - Certain phosphates are approved for specific food products

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1) National Provisioner (2015)

Product Application: Whole Bird Chicken

- Whole bird chicken testing done at Iowa State
- Yield increased 4.5% using 0.4% CF100M40 and 0.4% rice starch versus phosphate control
- Favorable taste, texture, and other sensory attributes

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Phosphate Replacement in Whole Bird Chicken

Comparative Formulas:

	Phosphate Control	0.4% Citri-Fi 100M40 0.5% Rice Starch
Ingredients	**%**	**%**
Chicken	85.00	85.00
Water	13.35	12.55
Salt	1.25	1.55
Sodium Tripolyphosphate	**0.40**	0.00
Citri-Fi® 100M40	0.00	**0.40**
Beneo Rice Starch Remyline® AX DR	0.00	**0.50**
Total	**100.00**	**100.00**

Usage Rates of Citri-Fi®:
Recommended usage rate is shown in the formula. However, rates may vary between 0.25-0.50 percent.

Incorporation Method of Citri-Fi:
Citri-Fi should be mixed into formula with dry ingredients, such as the salt.

Results:

	Oven Cooked Yield	Texture Rank	Taste Rank
Phosphate Control	65.5%	5	5
0.4% Citri-Fi 100M40 0.5% Rice Starch	70.0%	4	5

Note: Rank is based on a four point scale with 1: Worst and 5: Best.

	Panel Comments
0.4% Citri-Fi 100M40 0.5% Rice Starch	• Reduced purge both raw and cooked compared to Phosphate Control • Improved/maintained moisture retention after cooking and hold time • Texture attributes are comparable to Phosphate Control • No gel pockets between breast and tender

Conclusion:
The tables and figures above demonstrate that Citri-Fi 100M40 with the addition of Beneo rice starch can be used to maintain and/or improve taste and texture in injected chicken breasts when replacing phosphates. This testing was conducted at the Iowa State Meat Science Lab.

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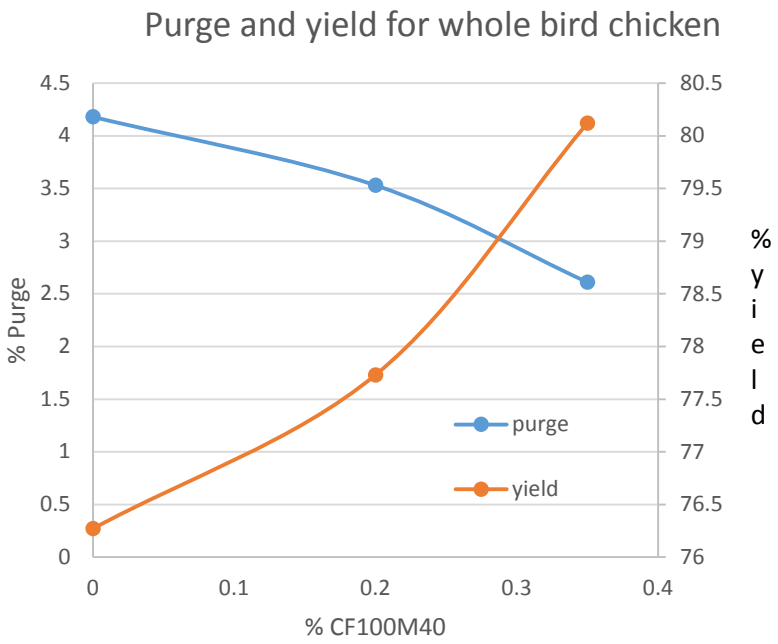
**Iowa State University Studies

Product Application: Whole Bird Chicken (cont)

- Reduced purge levels
  - Measured after holding whole birds for 24 hours after injection
  - Purge loss can be adjusted by adjusting CF level
  - Overall yields increased as well
- Significant cost savings to customers on both raw and cooked chicken



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**Iowa State University Studies

Brine Injection: Phosphate Replacement via Citri-Fi and Sodium Carbonate

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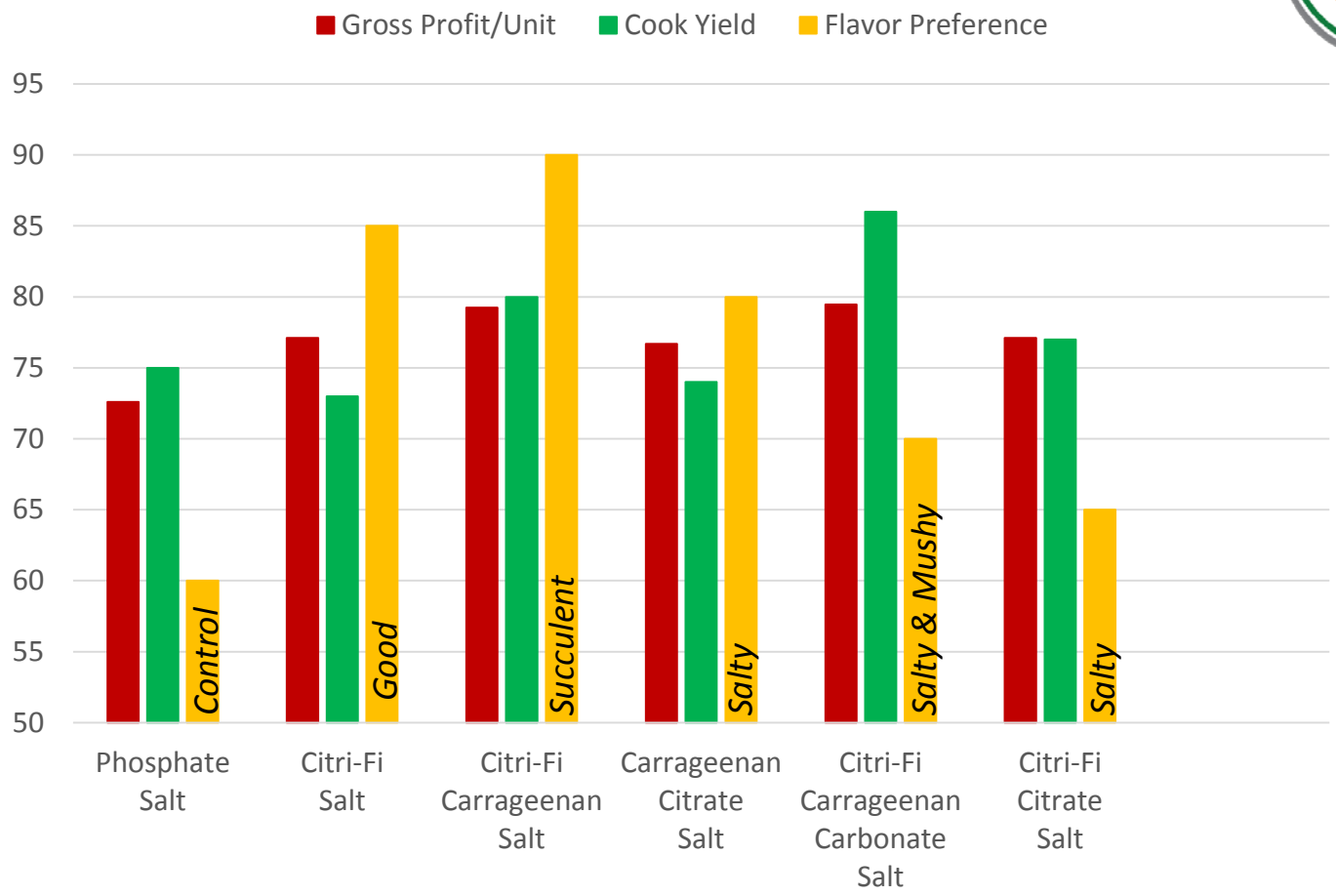
Injected Poultry Phosphate Replacement Formulations

Brine Formulas and Test Results						
Trial	Control	1	2	3	4	5
	(%)	(%)	(%)	(%)	(%)	(%)
Salt	1.20	1.20	1.20	1.20	1.20	1.20
STPP	0.24	-	-	-	-	-
Citri-Fi 100M40 or Citri-Fi 300M40	-	0.30	0.30	-	0.30	0.30
Carrageenan (Kappa)	-	-	0.30	0.30	0.30	
Sodium Citrate	-	-	-	0.50	0.50	0.50
Sodium Carbonate	-	-	-	-	0.30	-
Flavours & Spices	0.04-0.10	0.04-0.10	0.04-0.10	0.04-0.10	0.04-0.10	0.04-0.10
Water	19.70	19.69	19.63	19.53	19.47	19.59
Meat	78.86	78.81	78.57	78.47	77.93	78.41
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Cook Yield	75%	73%	80%	74%	86%	77%

**IMCD Australia testing

Citri-Fi Phosphate Replacement Results



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**IMCD Australia testing

Phosphate-free Brine for Meat Injection with Sodium Carbonate

	Control	Citri-Fi 100M40	Citri-Fi 100M40 + Na-Carbonate
Water	1000	1000	1000
Salt	60	60	60
Dextrose	24	24	24
Citri-Fi 100 M40	-	15	15
Na-Carbonate (Soda)	-	-	0.5
Recommended Injection Rate		10 – 20 %	

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**Testing and Application Work Submitted by Welding

Phosphate-free Brine: Effect of pH Adjustment

	Control	Citri-Fi 100 M40	Citri-Fi 100 M40 + Na-Carbonate
Results			
pH of brine	~ 7.2	**~ 6.2**	**~ 8.4**
1 h post injection:			
Salt in meat	**0.66 %**	**0.67 %**	**0.77 %**
Citri-Fi in meat	-	**0.17 %**	**0.19 %**
7 d post injection:			
pH of meat	**5.47**	**5.40**	**5.38**
Yield increase	-	**1.0%**	**4.25%**

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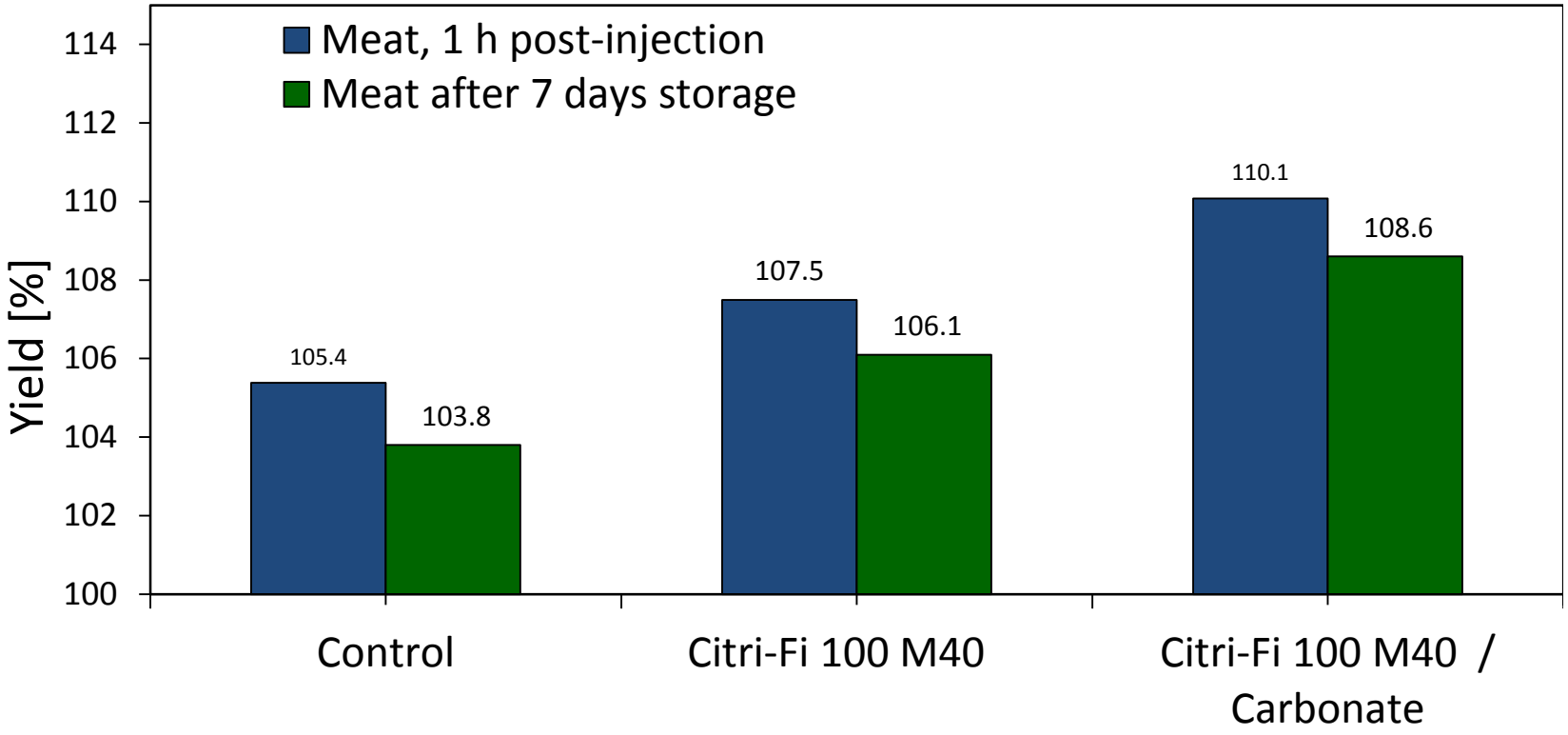
**Testing and Application Work Submitted by Welding

Phosphate-free Chicken Breast Injection: Yield



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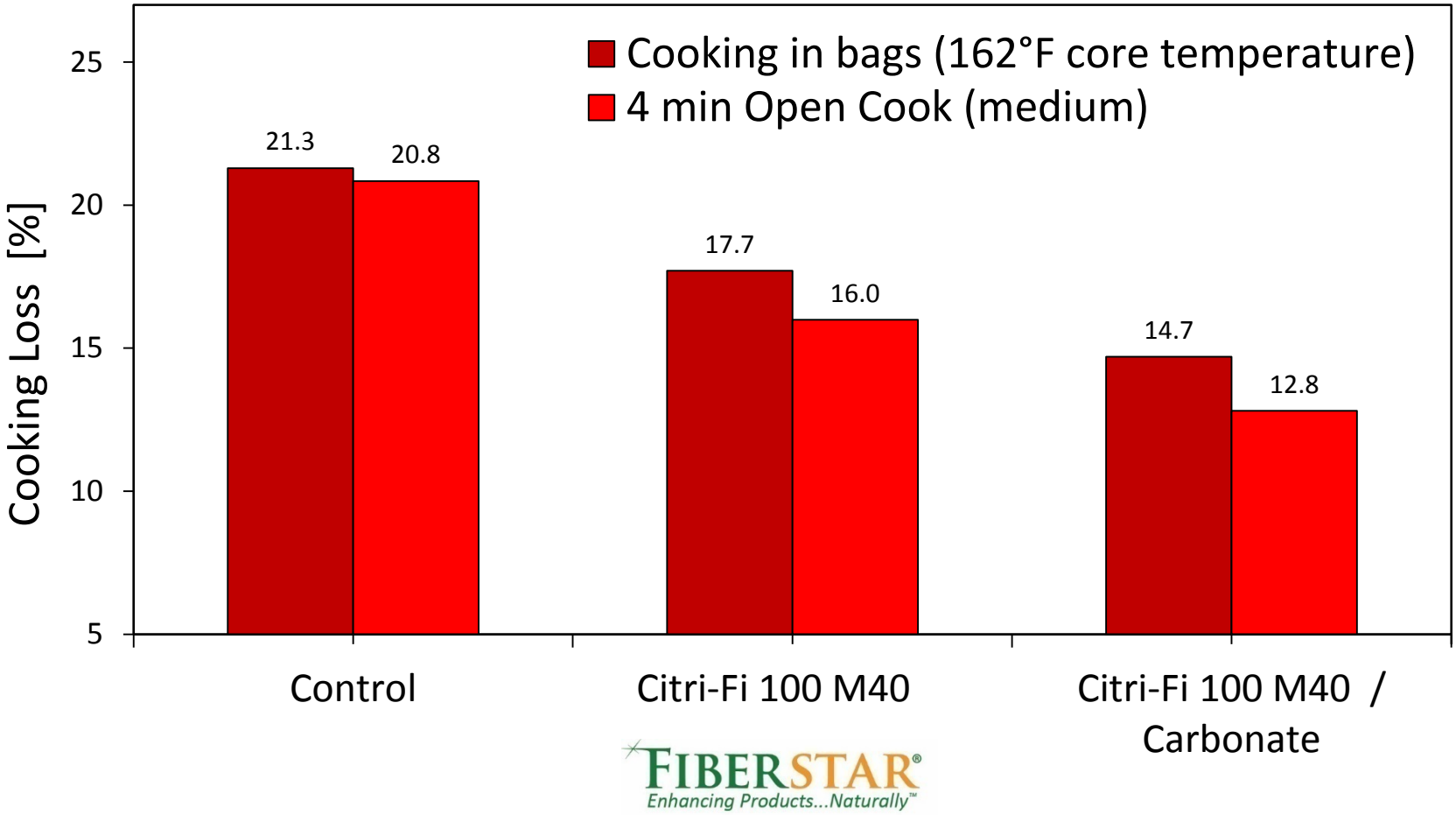
**Testing and Application Work Submitted by Welding

Phosphate-free Chicken Breast Injection: Cooking loss



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**Testing and Application Work Submitted by Welding

Phosphate-free Brine for Pork Loin Injection

	Control	Citri-Fi 100 M40	Citri-Fi 100 M40 + Na-Carbonate
Results			
pH of brine	~ 7.2	**~ 6.2**	**~ 8.4**
1 h post injection:			
Salt in meat	**0.28 %**	**0.38 %**	**0.49 %**
Citri-Fi in meat	-	**0.10 %**	**0.12 %**
7 d post injection:			
pH of meat	**5.65**	**5.73**	**5.58**
Yield increase	-	**2.26%**	**4.74%**

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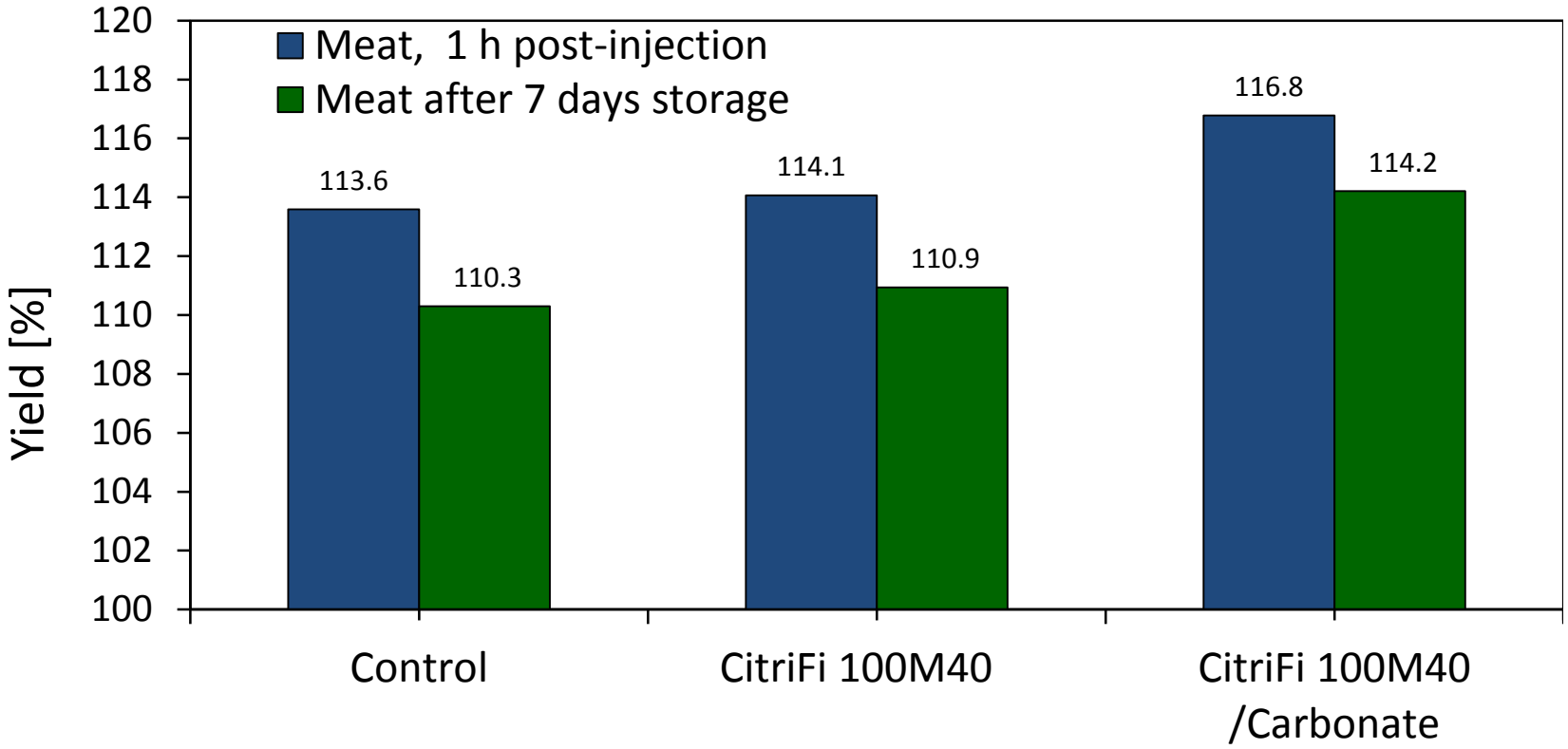
**Testing and Application Work Submitted by Welding

Phosphate-free Pork Loin Injection: Yield



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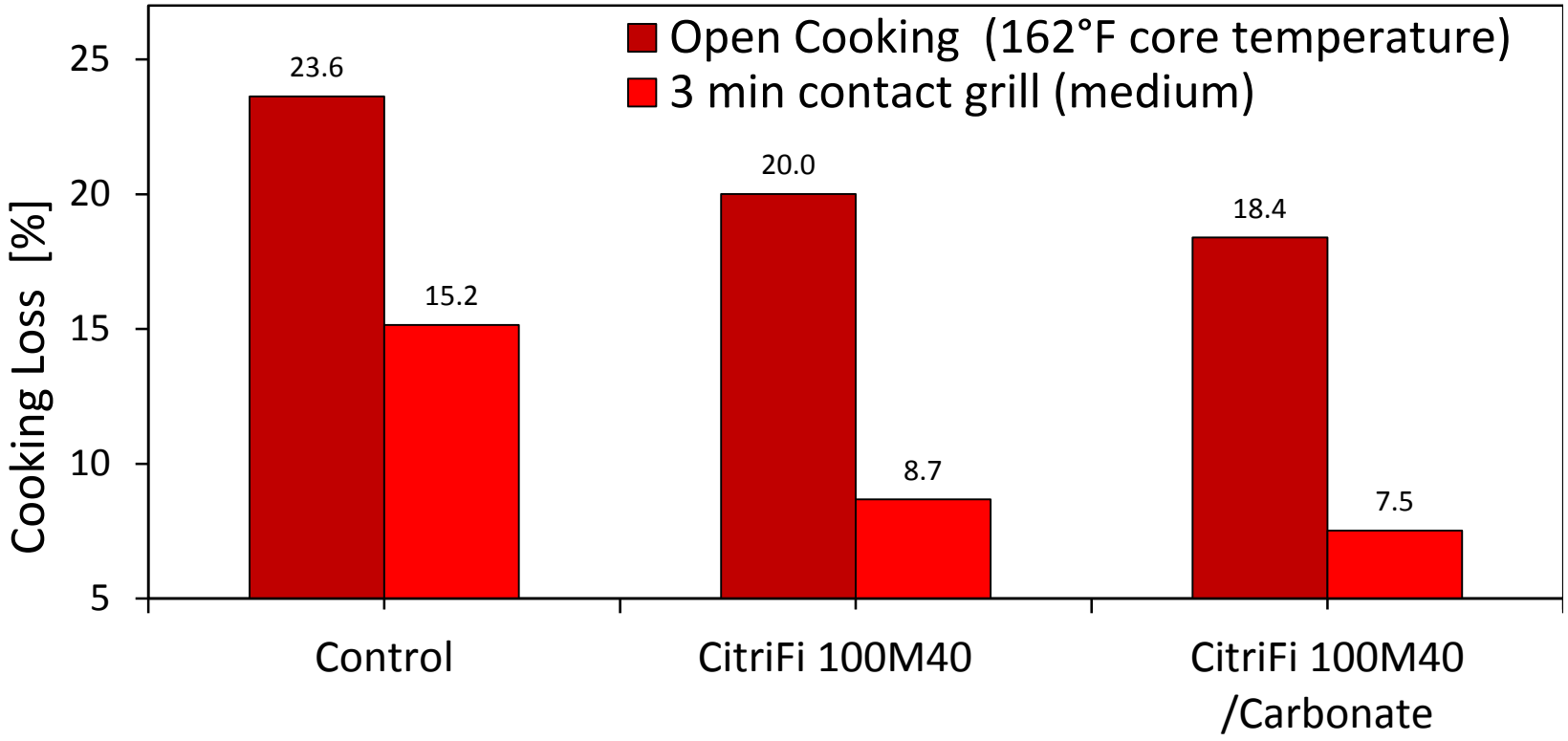
**Testing and Application Work Submitted by Welding

Phosphate-free Pork Loin Injection: Cooking loss



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**Testing and Application Work Submitted by Welding

Plated Rosemary for Brine Injection

- Rosemary oil is used as natural antioxidant and antimicrobial for meat applications
- Oil turned into powdered form w/ Citri-Fi via plating
- No additional emulsifier or carrier needed
- Plating avoids needing to spray dry for making oil a dry powder
- Citri-Fi softens off flavor / taste
- Citri-Fi also increased yields in meat

Ingredients	Grams	(%)
Citri-Fi 100M40	30.90	92.60
Rosemary Oil	2.46	7.40
Total	**33.36**	**100.00**

Control w/ Oil Separation -> with CF to Stabilize

Procedure:

1) Place rosemary in bowl
2) Drip in rosemary
3) Mix and screen

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Meat Marinades

Tumbling

Ingredient	Control Formula (kg)	Control Formula (%)	Citri-Fi Formula (kg)	Citri-Fi Formula (%)
Meat	67.10	67.0%	67.10	67.0%
Water	15.50	15.5%	15.50	15.4%
Seasoning	3.00	3.0%	3.00	3.0%
Vinegar	0.70	0.7%	0.70	0.7%
Lemon Juice	0.70	0.7%	0.70	0.7%
Oil	13.00	13.0%	13.00	12.9%
Citri-Fi 300FG	--	--	**0.50**	**0.5%**
Total	**100.00**	**100.0%**	**100.50**	**100.0%**

Conclusion:

- This is a great application for Sous Vide methods to maintain cling and control water during cooking

CITRI-FI USAGE:

Amount of Citri-Fi:

- Best results are found when Citri-Fi is incorporated at 0.5-1.5% of the total formula weight.

How to add Citri-Fi:

- Pre-mix Citri-Fi into the formula dry ingredients, such as salt or seasoning.
- After Citri-Fi is incorporated, follow your standard mixing procedures. No high shear mixing is required.
- Alternatively, Citri-Fi can be dispersed into at least 2 times its weight in formula oil prior to incorporation with other ingredients.
- ***Do not pre-hydrate Citri-Fi with water.***

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Meat Marinades

Meat Marinades Dry Rub

Formula:

	Control		0.2% Citri-Fi 100		0.2% Citri-Fi 300FG	
Ingredients	UNIT	%	UNIT	%	UNIT	%
Chicken Neck	528	96	526.9	95.8	526.9	95.8
Spice	22	4	22	4	22	4
Citri-Fi 300FG	0	0	0	0	1.1	0.2
Citri-Fi 100	0	0	1.1	0.2	0	0
Total	550	100	550	100	550	100

Citri-Fi Usage:

Amount of Citri-Fi:

- Best results are found when Citri-Fi is incorporated at 0.2% of the formula.

How to Add Citri-Fi:

- Pre-mix dry ingredients.
- Add dry ingredients to chicken necks.
- Tumble for 5 minutes at atmospheric pressure.
- Freeze in freezer bags.

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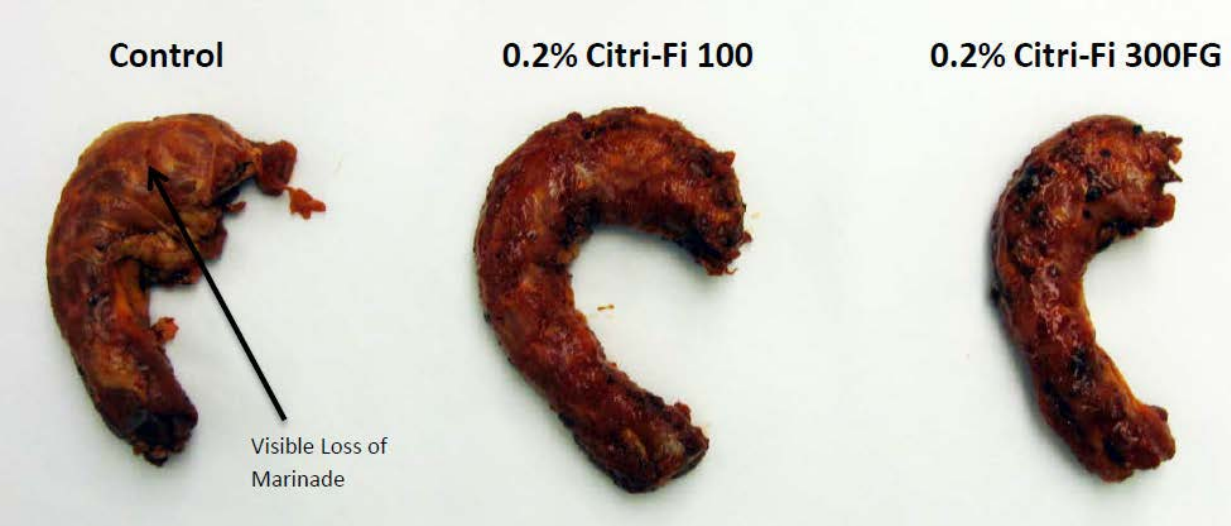
Meat Marinades

Results:

- Reduced tumble loss of dry rub using Citri-Fi® 100 or Citri-Fi® 300FG

Trial	Tumble Loss (%)	Observations
Control	2.18	Noticeable Drip Loss over Time
0.2% Citri-Fi 100	1.62	-
0.2% Citri-Fi 300FG	1.53	-



Source: Chicken Neck Study -Philippines

Ground/Minced Meat Preparations

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Citri-Fi in Ground Meat

Cost Reduced Formulation While Maintain or Improving Yields

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
	Control	0.25% Citri-Fi 100FG, 5% Water	0.5% Citri-Fi 100FG, 8% Water	0.65% Citri-Fi 100FG, 10% Water	0.25% Citri-Fi 125FG, 8% Water	0.65% Citri-Fi 125FG, 10% Water
Ingredients	%	%	%	%	%	%
Ground Beef	94.75	93.50	90.25	88.10	90.50	88.10
Salt	1.25	1.25	1.25	1.25	1.25	1.25
Citri-Fi 100FG	0.00	0.25	0.50	0.65	0.00	0.00
Citri-Fi 125FG	0.00	0.00	0.00	0.00	0.25	0.65
Water	4.00	5.00	8.00	10.00	8.00	10.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

Citri-Fi Usage

Best results are achieved when Citri-Fi is incorporated at 0.25-1% of the total formula weight. Additional water is recommended at 5-16% water.

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**Testing performed at Iowa State University.

Citri-Fi in Ground Meat

Purge Reduction

- Improved raw yield
- Reduced raw purge into drip pads
- Raw ground beef sample drip pads, 200g samples were held for 96 hours.
  - Control – 3.5 grams purge
  - Citri-Fi – 0.4 grams purge

Control

3.5 grams

Citri-Fi

0.4 grams

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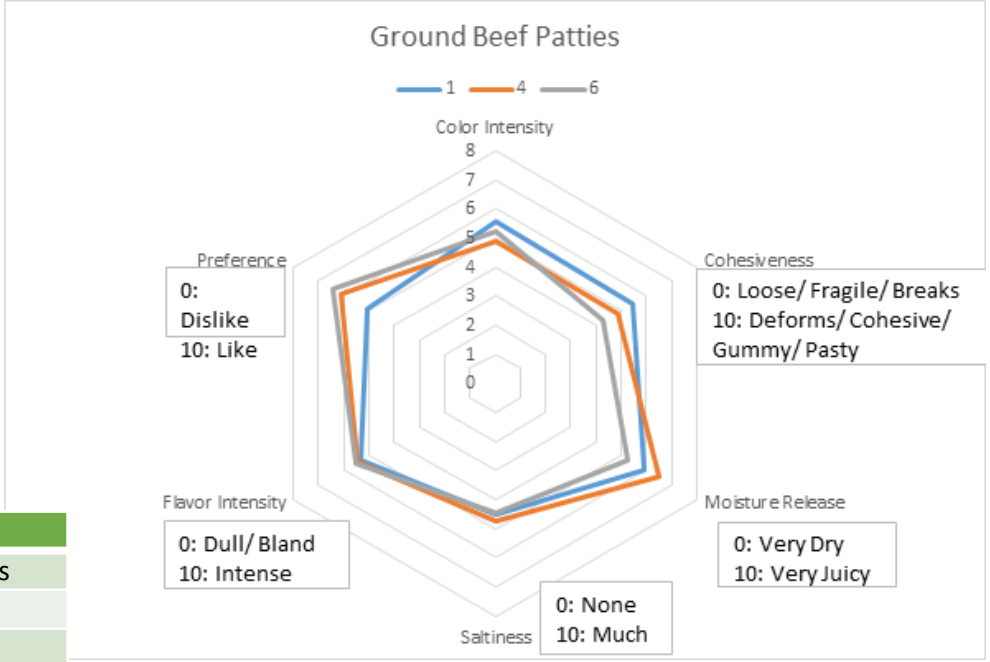
Iowa State Testing: Ground Meats

- Yield increase and improved sensory
- Cost reduction
- CF125 had best sensory
  - *Noticeable umami-type sensation*



	Cooked
Test	% of Savings
1) Control	--
2) 0.25% Citri-Fi 100FG 5% Water	--
3) 0.50% Citri-Fi 100FG 8% Water	3.4%
4) 0.65% Citri-Fi 100FG 10% Water	4.0%
5) 0.25% Citri-Fi 125FG 8% Water	2.0%
6) 0.65% Citri-Fi 125FG, 10% Water	2.6%

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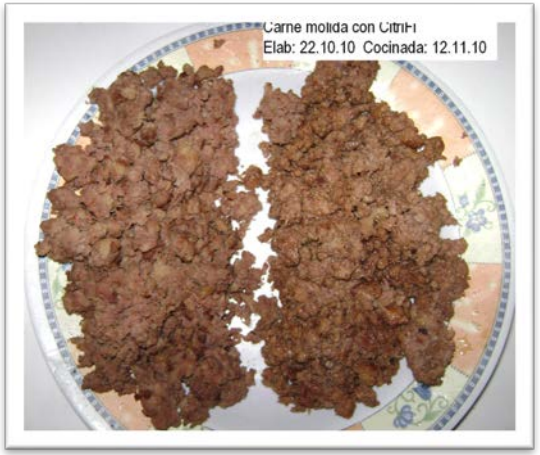
Citri-Fi to Increase Yield in Ground Meat Preparations

13% Extended Yield
with Citri-Fi & Sodium Lactate

Ingredient	Control %	Test %
Ground Beef	75.0%	67.1%
Water	25.0%	21.1%
Purasal S	--	3.0%
Citri-Fi 200	--	1.0%
Extra Water	--	7.8%
Total	100.0%	100.0%

**Testing and Application Work Submitted by Trisan Group

70% of consumers were not able to tell the difference in appearance between test and control.



59% of consumers were not able to tell the difference between test and control.

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Ground Meat and Sodium Lactate

Key Benefits:

- Improved Yield in Raw and Cooked Meat
- Reduced Purge and Drip-Loss
- Comparable Texture and Eating Qualities
- Anti-Microbial Benefits

Yield Results Citri-Fi 100

	Control	Citri-Fi 100 & Sodium Lactate	% Yield Improvement
Raw Yield	--	11.00%	+11.00%
Cooked Yield Day 1	54.94%	64.15%	+9.31%
Cooked Yield Day 7	48.82%	67.10%	+18.28%
Purge Day 7	7.00%	0.00%	7.00% reduction

Yield Results Citri-Fi 200

	Control	Citri-Fi 200 & Sodium Lactate	% Yield Improvement
Raw Yield	--	12.00%	+12.00%
Cooked Yield Day 1	54.94%	77.29%	+22.35%
Cooked Yield Day 7	48.82%	62.98%	+14.16%
Purge Day 7	7.00%	2.07%	4.93% reduction

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Ground Meats—Conclusions

- Incorporate Citri-Fi in with other dry ingredients if possible
- Key to cost saving is adding water or using lower cost meat using Citri-Fi's ability to bind and hold the water and fat through cooking
- Cooked yields tend to be similar as controls
- Reduce moisture loss and dry appearance when used in steam tables
- Keeps meat fillings from soaking into tortilla shells, wraps, or bready doughs

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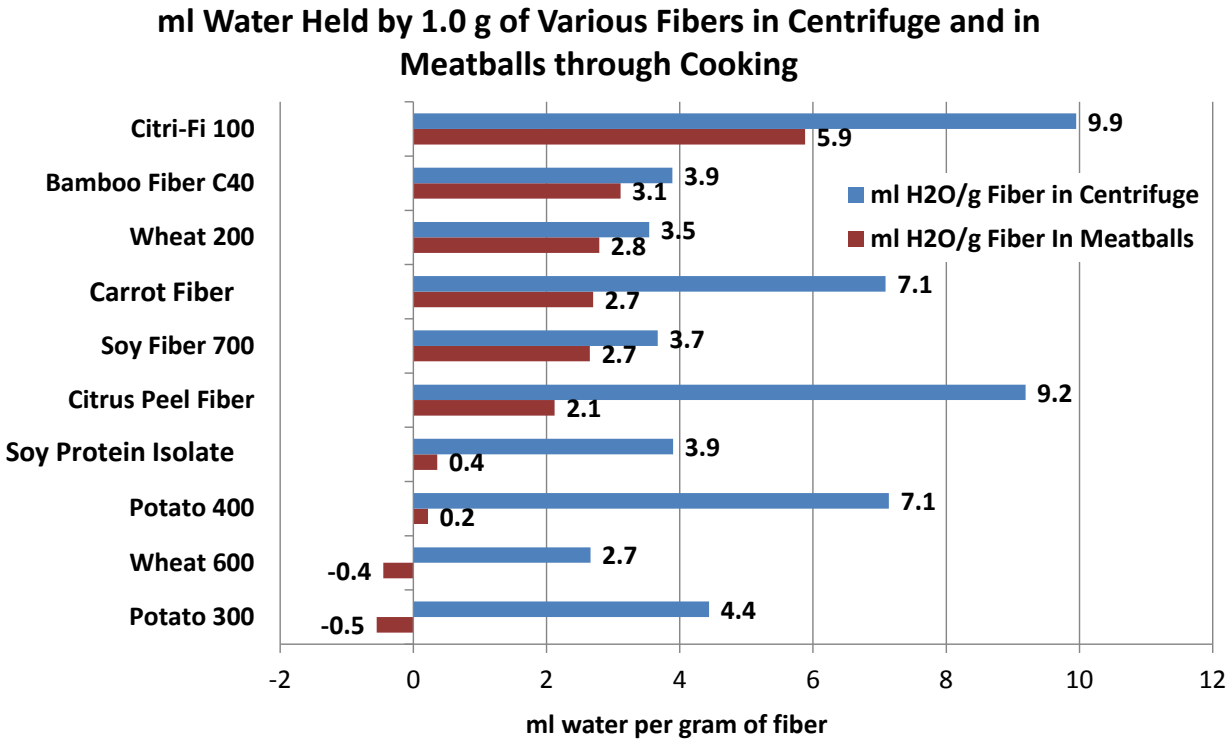
Fiber Comparisons



Water Holding Capacity of Various Fibers in a Centrifuge

A comparison of the water binding functionality of various fibers measured in ml of water retained per gram of fiber.

Water Holding Capacity of Various Fibers in Meatballs

Each product was used in identical meatball formulas (ground meat, salt and fiber). After cooking, the meatballs were weighed to compare yields. Meatballs containing 1.0% Citri-Fi 100 held 2.1 times more water than meatballs containing 1.0% wheat fiber. Meatballs made with potato 300 and wheat 600 purged more water than the control meatballs that contained no fiber.

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*Water Holding Capacity Measured by the AACC - Standard Method # 56 - 30

Citri-Fi for Use in Hot-Dogs / Frankfurters

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Citri-Fi in Hot Dogs

Ingredients	Control %	CitriFi100 %
Pork Meat II	52	51.5
Pork Fat	20	20
Ice	20	20
Seasoning	0.6	0.6
Salt Nitrate	2.0	2.0
Phosphates + Antioxidants	0.4	0.4
Citri-Fi® 100	0	**0.5**
Potato Starch	5	5
Total	100	100

The emulsion was stuffed in permeable cellulose casings

	Heat Treatment	
Redden	60 °C	20 min
Drying	70 °C	20 min
Smoking	68 °C	15 min
Cooking	78 °C	15 min
Drying	70 °C	10 min
Shower		10 min

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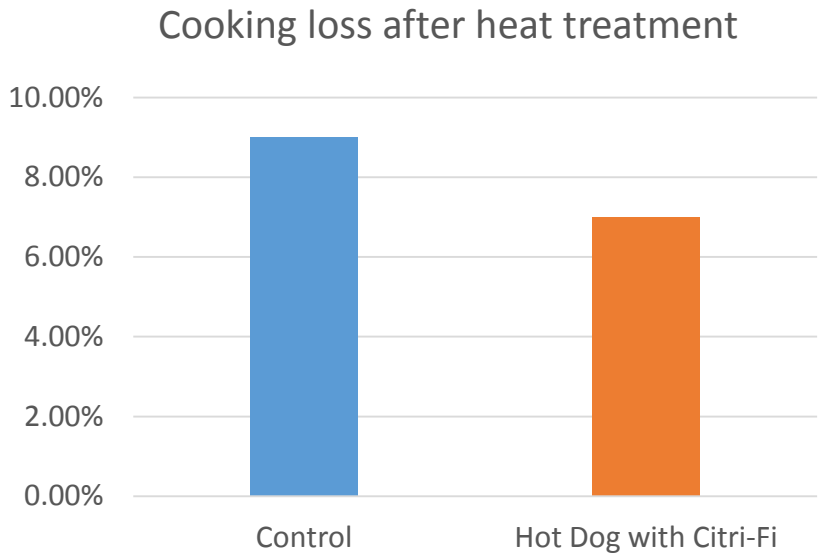
Citri-Fi in Hot Dogs

- Citri-Fi is used at 0.5 % of the final formula weight to:
- Reduce the cooking loss during heat treatment
- Reduce the purge in the packs

- Improve binding of the emulsion



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Citri-Fi for Use in Gyros – Doner Kebab

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Production of Gyros

Meat Slicer
3-5mm

Brine preparation including CF100

Tumbling
25 – 30 min,
8-10 rpm,
full vacuum,
Temperature 2°C.

Setting up gyros on roast jacks

Gyros is wrapped with stretch film and packed

The final product is distributed frozen to the final customer

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*Photos provided by Sivvas

Technical Challenges with Gyros – Doner Kebab Production:

- Difficulty in increasing yield and still retaining the natural appearance during grilling
- High drip loss - up to 40% during grilling
- Improving the stability and adhesion of the finished product
- Replacing phosphates and other E-numbers with E-number-free components - Phosphates are not allowed in pork gyros in EU

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Trial Formulas & Results

	Ingredients	Control kg	Gyros with Citri-Fi 100 kg
	Pork Meat (Slices 2-5mm)	100.00	100.00
BRINE	Water	**14.00**	**16.50**
	Tumbling Mix For Gyros	1.20	1.20
	Spices	1.00	1.00
	Salt	1.00	1.00
	CITRI FI 100		**0.5**
	TOTAL	117.20	120.20

Results

Yield after tumbling (raw)	**17.20%** →	**20.20%**
Cooking loss	**38.00%** →	**34.00%**

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Benefits of Citri-Fi

- Increases the raw yield (frozen uncooked product)
- Reduces drip-loss during grilling
- Improves the adhesive strength of the product.
- Improves declaration: clean up labels
- Multiple functions of the Citri-Fi : moisture control, fat control, provide adhesion - binding
- Allergen free

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Citri-Fi Incorporation

- Citri-Fi 100 Product Line: Citri-Fi 100 / 100FG
- Amount of Citri-Fi: Best results are found when Citri-Fi is incorporated at 0.2-0.8% of the total formula weight and 3-5 times extra water per weight of Citri-Fi
- How to add Citri-Fi:
  - Gyros – Chicken Doner (slices of meat in tumbler): Pre-mix Citri-Fi into the formula dry ingredients. Add dry mix in the brine.
  - Doner Kebab (ground meat in mixer): Add it as dry ingredient in the mixer with the rest binding ingredients.

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Citri-Fi® in Vegan Burger

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Trial Formulas & Results

Ingredients	Citri-Fi 100 FG & Methyl Cellulose	Citri-Fi 100 FG	Control
		%	
Texturized Soybean Protein	25.0	23.3	23.3
Wheat Gluten	6.0	10.0	10.0
Plant Oil	10.0	10.0	10.0
Citri-Fi 100	1.5	2.0	-
Methyl Cellulose	1.0	-	-
Wheat Flour	-	-	6.0
Salt	1.8	1.8	1.8
Spices	0.8	0.8	0.8
Onion & Garlic Powder	0.6	0.6	0.6
Flavour	1.5	1.5	1.5
Water	51.8	50.0	46.0
Total	**100.0**	**100.0**	**100.0**

Vegan Burger Ingredients

Binding, Emulsification & Moisture Control
Fiber

Nutritional Value: Protein, Fat, Fiber
Texture , Binding & Taste

Flavor & Taste

Process in Steps (1)

Fig 1: Dry powders in water

Fig 2: Adding oil to dispersion

Fig 3: Emulsion with Citri-Fi and Gluten

1. Mix dry ingredients (except texturized protein).
2. Disperse (1) in water using a mixer or chopper at low speed until well hydrated.
3. Add oil and emulsify at medium speed.
4. Add dry texturized protein and mix. Note: Depending on shear speed, coarse or finer textured structure can be achieved.

Fig 4: Adding texturized protein

Fig 5: Mixing emulsion with texturized protein

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Process in Steps (2)

5. Wait 2 hours or leave over night before forming patties to have texturized protein completely swollen.

Fig 6: Placing raw mass in forming plate

Fig 7: Formed patties

6. Cook patties in steam and pan fry.

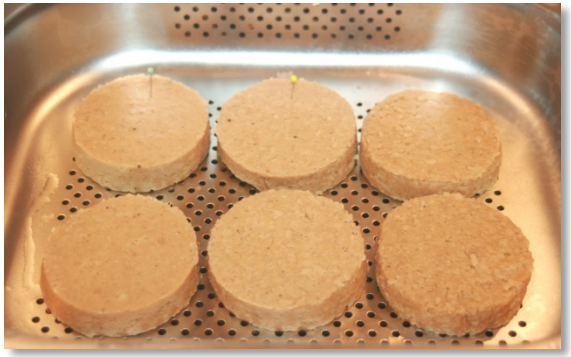

Fig 8: After steam cooking at 100°C for 15 min

Fig 9 : Pan frying for 5 min

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Effect of Citri-Fi: Forming Patties

Tested in Formula 2 with only Citrus Fibre

- **Viscosity of raw mass can be easy adjusted**
- **Stickiness is reduced**
- **Form stability can be achieved**

1.0 % 1.5 % 2.0 % Citri-Fi 100 FG

Effect of Citri-Fi: Pan Frying

Tested in Formula 2 with only Citri-Fi

- **Form stability during heat treatment**

- **Improved shape and bite**

1.0 % 1.5 % 2.0 % Citri-Fi 100FG

Trial Results: Appearance and Yield

Cooking Yield	Citri-Fi & Methyl Cellulose	Citri-Fi 2%	Control
Pan frying for 5 min	96.7 %	97.6 %	95.1 %

Conclusion

- Citri-Fi adds a nutritional benefit to burger: enhances the dietary fibre content and lowers the carbohydrate/starch content.
- Citri-Fi improves the organoleptic properties: burger is more meat like and has improved juiciness.
- Frying/Cooking loss is reduced compared to binding with flour.
- Chemical modified ingredients for binding and emulsification are not needed.

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Citri-Fi in Meats Summary

- Yield improvement
  - Binds both fat and water
- Water addition
  - Typically 7-10 times the CF weight
- Fat binding and emulsification
  - Reduced fat
  - Improve sensory
- Marinades and brines
  - Low viscosity yet high water capacity with small particle size
  - Phosphate replacement with starch or carrageenan
  - No gel pockets
- Synergies with starches, carrageenan, lactates, phosphates

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Commercial Examples

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Commercial Examples

AUSTRALIA

Chicken; Water; Salt; E326; E262; Soy Protein; E407; E451; E450; E452; E508; Hydrolysed Maize Protein; Maltodextrin; Maize; **Citrus Fibre**; Dextrose; E223; Sugar; Herbs; Spices; Yeast Extract; Dehydrated Vegetables; Vegetable Oil

Chicken; Seasonings; Rice Flour; Sugar; Maize Starch; Salt; Potato Starch; Vegetable Powder; Maltodextrin; Honey Powder; **Citrus Fibre**; Chilli; Flavorings; Preservatives; Spice Extracts; Acidity Regulators; Rice Bran Oil

Beef; Water; Pepper & Parsley Seasoning; Salt; Sugar; Rice Flour; Dehydrated Vegetable Powder; Pepper; Parsley; Vegetable Oil; Flavoring; E330; E160c; E451; Actinidine; Vegetable Powder; **Citrus Fiber**; E415; Yeast Extract; Spice Extracts

(Global Data, 2012 – 2017)

Commercial Examples

FINLAND

Pork; Water; Canola Oil; E262; Potassium Lactate; Sugar; Salt; Flavorings; Spices; Cayenne Pepper; Black Pepper; Red Pepper; Onions; Garlic; Turmeric; Corn; **Citrus Fiber**; E450; E451; Carrageenan; Glucose; Modified Potato Starch; E315; Carotenoid Coloring

UNITED KINGDOM

Battered Chicken; Chicken Breast Fillet; Chicken Breast; Maize Starch; Salt; **Citrus Fiber**; Tapioca Starch; Rosemary Extract; Tempura Batter; Maize Flour; Fortified Wheat Flour; Calcium Carbonate; Iron; Niacin; Thiamin; Corn Flour; Wheat Starch; Sodium Bicarbonate; Diphosphates; Flavoring; White Pepper; Canola Oil; Rice Flour Predust; Rice Flour; Bread Crumbs; Wheat Flour Blend; Yeast; Sunflower Oil; Sweet And Sour Sauce; Water; Sugar; Malt Vinegar; Tomato Ketchup; Tomato Puree; Spirit Vinegar; Cinnamon; Cayenne Pepper; Brown Sugar; Concentrated Pineapple Juice; Rice Wine; Rice; Soy Sauce; Soybeans; Garlic Puree; Ginger Puree; Paprika Extract

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(Global Data, 2012 – 2017)

Commercial Examples

USA

Eggs; Whole Milk Mozzarella Cheese; Cultured Pasteurized Part Skim Milk; Salt; Enzymes; Bacon; Water; Sugar; Smoke Flavoring; Sodium Phosphate; Sodium Erythorbate; Sodium Nitrite; Soybean Oil; Spinach; Parmesan Cheese; Modified Corn Starch; **Citrus Fiber**; Parmesan Cheese Flavor; Whey Solids; Natural Parmesan Cheese Flavor; Soy Lecithin

Light Tuna; Cayenne Pepper Sauce; Aged Cayenne Red Peppers; Vinegar; Water; Salt; Garlic Powder; Buffalo Sauce; Hot Sauce Powder; Maltodextrin; Garlic; Natural Flavor; Yeast Extract; Paprika; Citric Acid; Extractives Of Paprika; Sodium Diacetate; Spices; Modified Corn Starch; Xanthan Gum; **Citrus Fiber**

(Global Data, 2012 – 2017)

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Commercial Examples

USA

Light Meat Tuna; Water; Tomato Paste; Brown Sugar; Vinegar; Sunflower Oil; Dehydrated Tomatoes; Dehydrated Garlic; Dehydrated Onion; Salt; Paprika; Spices; Modified Corn Starch; Yeast Extract; Potassium Chloride; Molasses Powder; Natural Smoke Flavor; Honey; Natural Flavor; Xanthan Gum; **Citrus Fiber;** Citric Acid

Pork; Beef; Water; Seasonings; Sugar; Paprika; Spices; Chili Pepper; Black Pepper; Sage; Nutmeg; Marjoram; Yeast Extract; Garlic Powder; Oleoresin Capsicum; Salt; **Citrus Powder**; Grapefruit Pulp; Grapefruit Fiber; **Orange Pulp; Orange Fiber**; Tangerine Pulp; Tangerine Fiber; Lemon Pulp; Lemon Fiber; Lime Pulp; Lime Fiber

(Global Data, 2012 – 2017)

Citri-Fi 125 Student Contest Submissions

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Citri-Fi 125 Contest – Meat & Poultry Submissions

1. **Adding Citrus Fiber in Making Pork Bologna**
   - (Ho Chi Minh City University of Technology and Education, Vietnam)
   - Partial phosphate replacement to promote and reduce production costs
2. **New Application of Citri-Fi 125 to Enhance Shelf Life of Fresh Meat**
   - (University of Wisconsin, Stout, USA)
   - Natural antimicrobial ingredient applied on a meat surface without compromising texture
3. **Nashville-style Hot Chicken Sauce**
   - (Ohio State University , USA)
   - Partial oil replacement, spice/salt blend reduction and natural emulsification stabilization to prevent settling
4. **Fried Fish Ball using Citri-Fi 125**
   - (Ho Chi Minh University of Technology and Education, Vietnam)
   - Modified starch replacement to remove additives and improved texture
5. **Adding Citrus Fiber in Pate Making**
   - (Ho Chi Minh University of Technology and Education, Vietnam)
   - Partial phosphate replacement to reduce additive use

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Citri-Fi 125M40 as a Fat Blocker

Innovation Challenge Winner –Oregon State University

Coating System	Citri-Fi 125 (%) Use	% Pick-up	% Fat
Control	0.00	26.40	9.1
Citri-Fi in Predust	0.25	34.61	8.7
Citri-Fi in Batter	0.25	27.84	8.9
Citri-Fi in Breading	0.25	35.14	8.9
Citri-Fi in Predust	0.50	37.53	7.8
Citri-Fi in Batter	0.50	29.76	8.6
Citri-Fi in Breading	0.50	39.04	7.4

Figure 1. Flow diagram of sample preparation: 1. Thawed whole fish, 2. 2" cut fish portions, 3. Pre-dust, 4. Batter, 5. Breading, 6. Placed in deep fryer, 7. Deep frying at 350°F for 3 min, 8. Cooling on wire rack for 5 min, and 9. Testing (lipid, texture, moisture and color).

Benefits:

- Reduced Oil Pickup (20% or more)
- Increased Yield
- Increased Crispiness

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4th Place in 125 Student Challenge

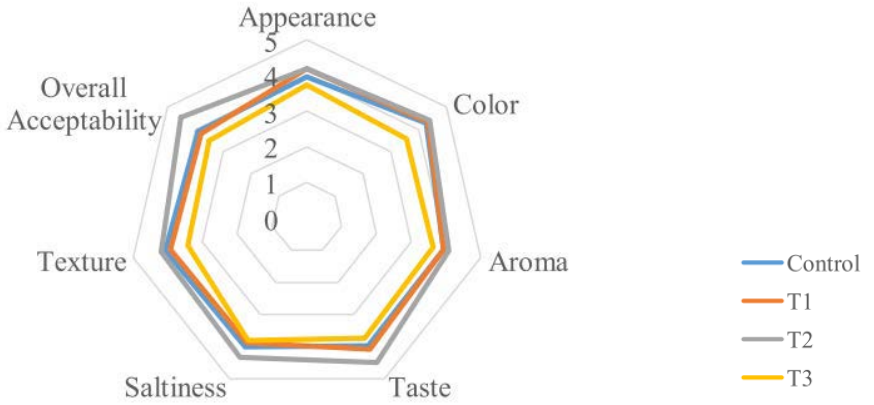
Chicken Sausage With Reduced Oil & Improved Sensory Sri Lanka

Rationale: Citri-Fi 125M40 was used in the oil emulsions with the objective of replacing vegetable oil content in the oil emulsion. Three oil emulsions were prepared with different levels of incorporated citrus fiber.

Testing Done: Product development and sample preparation was done at Cargill's Quality Foods, Sri Lanka.

Findings: Citri-Fi samples lowered cost, reduced fat, while taste, texture and color were found to be improved

30 Member Sensory Panel



Ingredient	Emulsion 1	Emulsion 2	Emulsion 3
		%	
Isolated Soy protein	11.30	11.30	11.30
Salt	1.30	1.30	1.30
Vegetable oil	25.00	18.75	15.62
Ice and water	62.40	67.90	70.60
Citrus fiber		0.78	1.17
Total	100.00	100.00	100.00
% of vegetable oil replaced		25.00	37.50

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