

Atlantic Poultry Conference
2018

White Striping and Woody Breast in the Broiler Meat Industry

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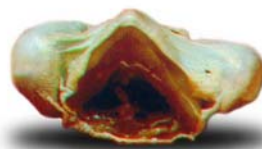
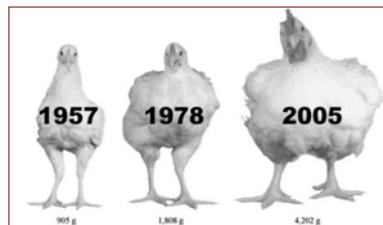


Boneless Breast Meat in the Market



- ❖ **Boneless breast meat is the popular meat of choice among the consumers**
- **Retail fresh, further processed, prepared foods, foodservice**
- **Portioned breast meat common for foodservice, sourced from larger broilers**

Genetics and Growth Rates are Changing: Not the same bird!



~0.9 kg
1957

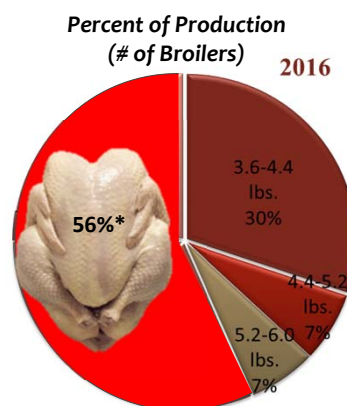


~3.6 kg
2014

Zuidhof et al., 2014

Broiler Market Trends

- High breast meat yielding broilers
- Increased bird size
- Shorter growth period (faster growth rate)
- Various markets
- Big bird programs- Large % of U.S. market

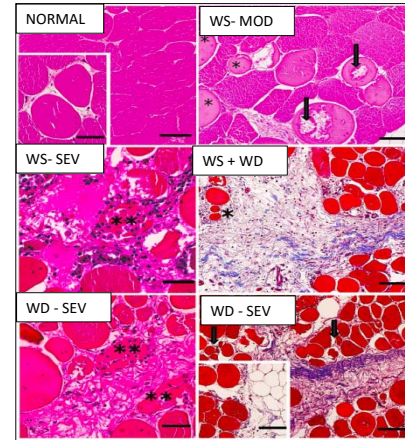


*68% of meat produced!

> 6 lb: 42% in 2010 and 23% in 2000

Breast Myopathies

- **Recent: growth related myopathies**
- **Myopathies show histological lesions**
 - Fiber degeneration, fibrosis, lipid infiltration, inflammatory cells, etc.
- ***Mazzoni et al. (2015) reported that all breast from heavy broilers had histological lesions, but % of fibers affected varies***
 - >20% fibers show degeneration in severe cases
- **White striping and Woody Breast**



Kuttappan et al., 2013 Sihvo et al., 2014;
Trocino et al., 2015; de Brot et al., 2016

Economic Losses

- **Condemnation**
 - trim, whole fillet, or carcass!
- **Decreased yield**
 - Drip loss, Cook loss, Marinade retention
- **Decreased value (downgrades)**
- **Adding and training personnel for grading/sorting**
- **Lost business?**



\$200 million
USD, Annually, conservative

Kuttappan et al., 2016

Breast Myopathies/Meat Quality

Industry Concerns?

YES!

Why?

- Quality defect at high incidence
- Downgrades/Condemns
- Customer (restaurants) complaints
- Consumer awareness
- Economic losses

UNITED STATES DEPARTMENT OF AGRICULTURE FOOD SAFETY AND INSPECTION SERVICE WASHINGTON, DC		
FSIS NOTICE	35-17	7/5/17
DISPOSITION INSTRUCTIONS FOR "WOODY BREAST" AND "WHITE STRIPING" POULTRY CONDITIONS		

I. PURPOSE

This notice provides disposition information for conditions occurring in the breast muscles of broiler chickens referred to as "Woody Breast" or "White Stripping." Upon issuance of this notice, Public Health Veterinarians (PHVs), Inspectors-in-Charge (IICs), Front Line Supervisors (FLSs), and Supervisory Consumer Safety Inspectors (SCSIs) as appropriate are to correlate with inspection program personnel (IPP) on how to identify and verify that poultry establishments are removing trimmable inflammatory tissues that may be associated with these conditions.

The picture below shows a thick, gelatinous fluid, yellow in color on the left side of this picture. On the right side there are several very small hemorrhages in a cluster. There is an overall shiny surface indicating excess fluid in the tissue. These associated inflammatory tissues require trimming.



In the Media.....

MEAT+POULTRY

HOME NEWS WRITERS MULTIMEDIA RESOURCES

Home > Writers > Other Contributors

Writers

Bernard Shine
Joel Crews
Keith Nunes
Richard Alaniz
Dr. Temple Grandin
Other Contributors

FREE WEBINAR

ADVANCES IN
KILL FLOOR
TECHNOLOGY

Mysterious myopathy

SEPT. 27, 2016 - BY KIMBERLEE CLINE

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THE WALL STREET JOURNAL

Poultry's Tough New Problem
By Donald Young
Published on 11-11-16
The Wall Street Journal

Poultry's Tough New Problem: 'Woody Breast'

By Donald Young
Published on 11-11-16
The Wall Street Journal

Check out the latest chicken diseases.



Yes, sadly, these are actually real diseases that affect the quality of chicken meat (people don't seem to care about the chickens themselves). All of these are caused by the Frankensteinian breeding practices used by the industry.

Source: GoulStreet.com

VeganStreet.com
patron.com/veganstreet

White Striations

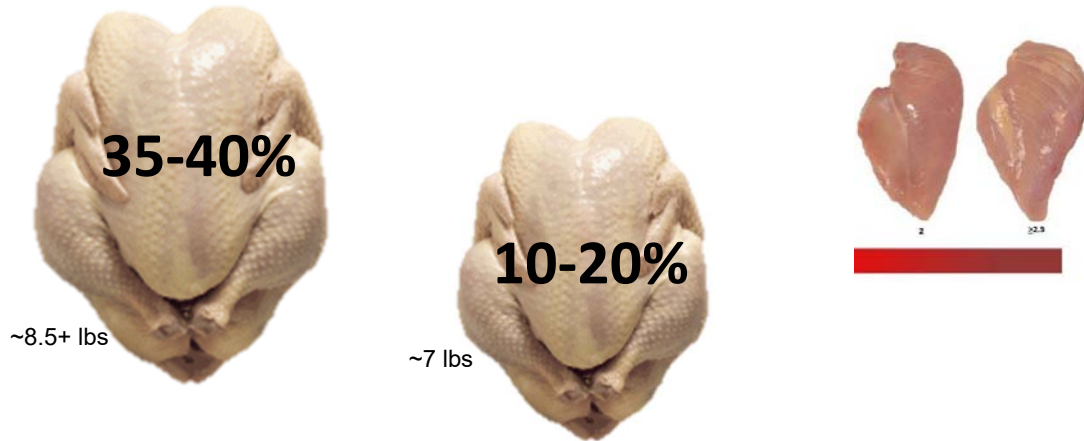
- White striping is the occurrence of varying degrees of white striations
- Commonly seen on breast fillets and thighs
- An emerging tissue in broiler meat industry
 - Global markets



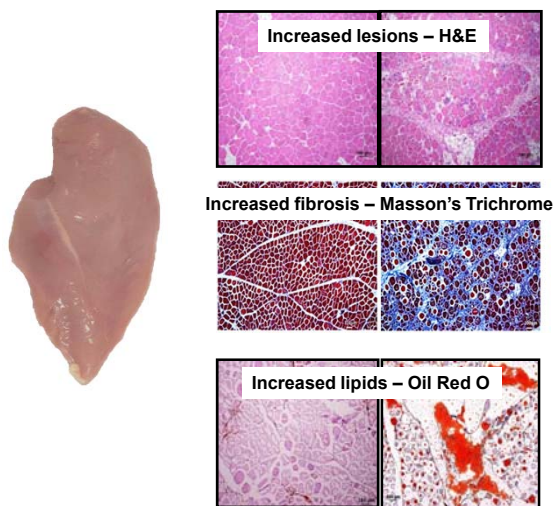
Varying Degrees of Severity



Incidence of SEVERE WS in Commercial Plants



multiple plants, strains



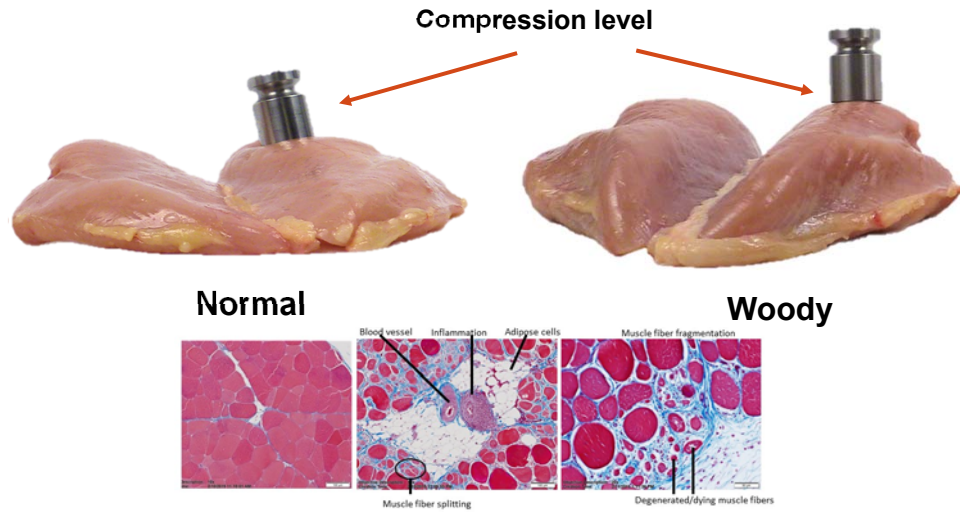
Composition:

- Increased Fat
- Decreased Protein

- Increased protein breakdown
- Increased expression of proteolytic genes (Murf-1, Atrogin-1)

Kuttappan et al., 2013
Vignale et al., 2016

Wooden "Woody" Breast

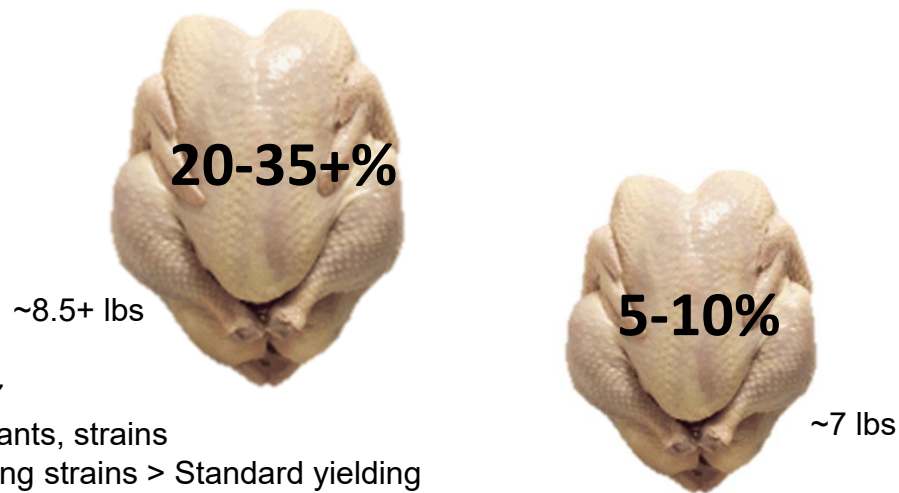


Kuttappan et al., 2016

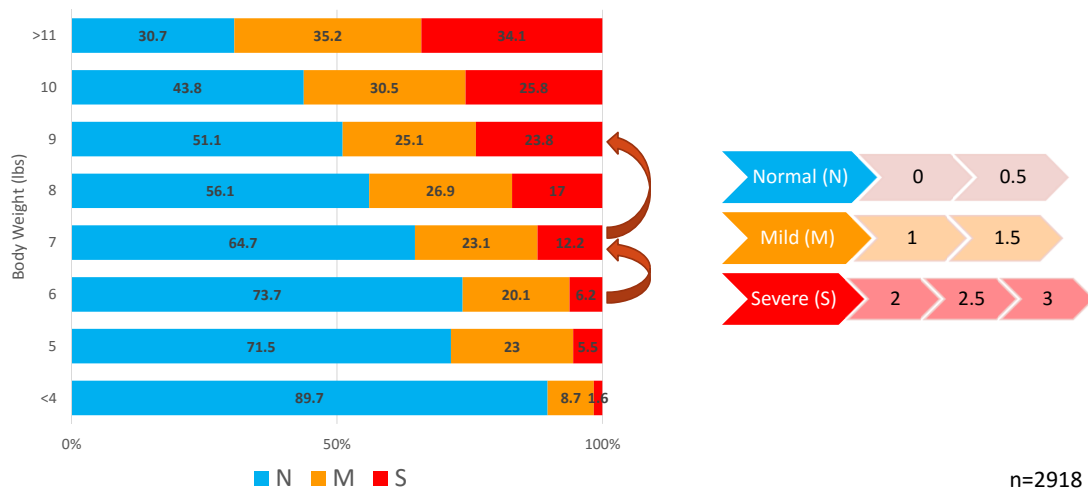
Woody Breast: Varying Degrees of Severity



Incidence of MODERATE and SEVERE WB in Commercial Plants



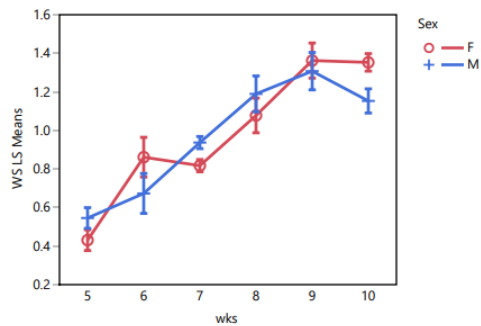
Incidence of Woody Breast in Broilers by Weight



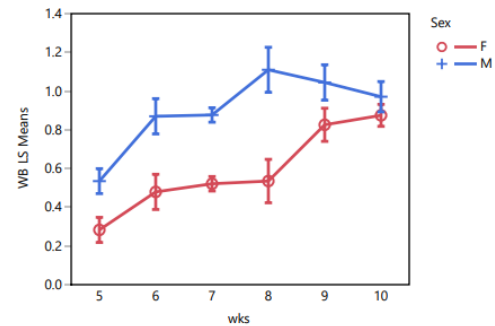
Straight run commercial crosses

Mallmann et al., 2018

White Striping and Woody Breast: Effect of AGE and Sex



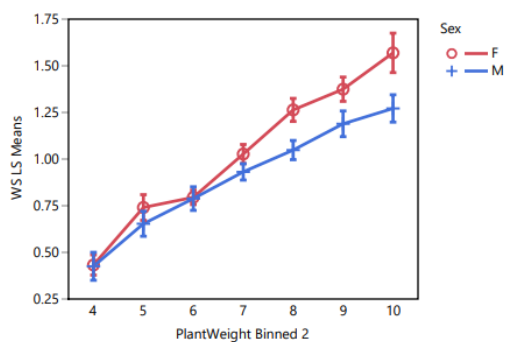
White Striping
Sex $P > 0.05$
n=4651



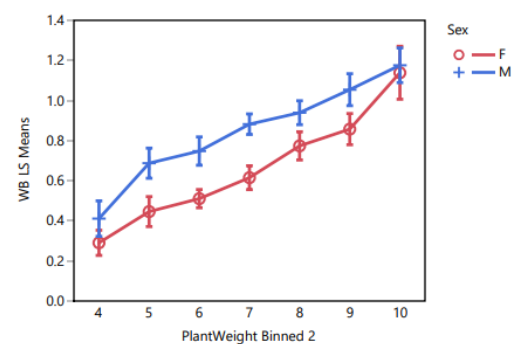
Woody Breast
Sex $P < 0.05$
n=5423

3 main broiler lines

White Striping and Woody Breast: Effect of WEIGHT and Sex



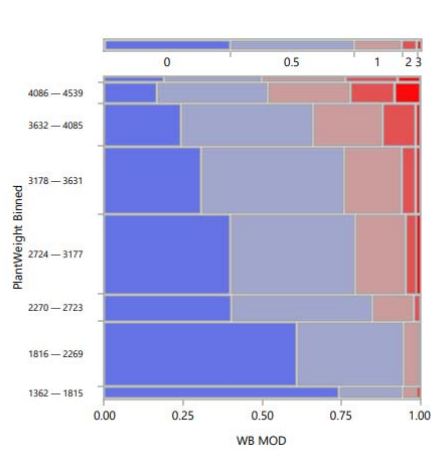
White Striping
Sex $P < 0.05$
n=4651



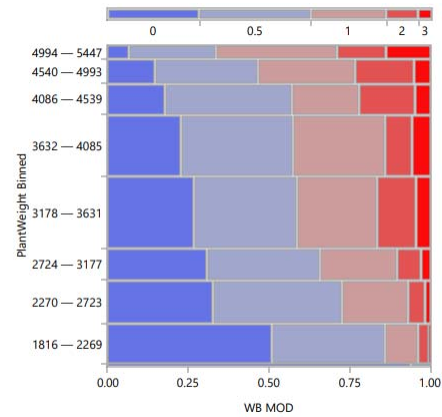
Woody Breast
Sex $P < 0.05$
n=5423

3 main broiler lines

Woody Breast: Effect of Plant Weight by Sex



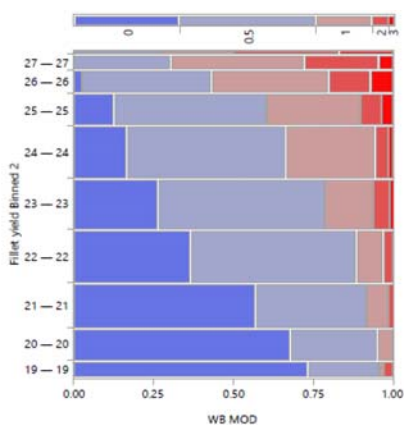
Females
n=1396



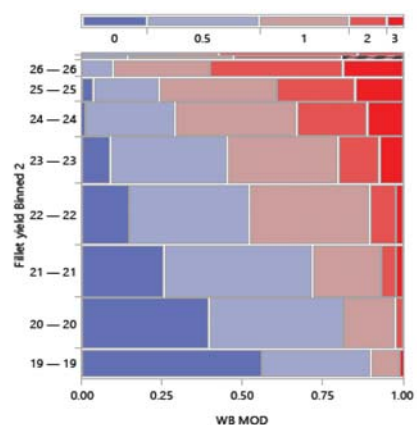
Males
n=1347

Top 3 Broiler Strains

Woody Breast: Effect of Fillet Yield by Sex



Females
n=1396

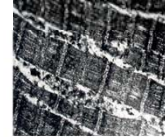


Males
n=1347

Top 3 Broiler Strains

Meat Quality of Woody Breast

- Increased sarcomere length
- Increased hemorrhagic score
- Higher pH
- *Decreased water holding capacity (increased loss) due to loss of myofibrillar protein*
- Appearance affected
- Shear, not always impacted; not contractile toughness
- *Complex texture*



Tijare et al., 2016; Mudalal et al., 2015; Kuttappan et al., 2017

Compositional Changes

- Decreased protein %
- Increased fat % (WS+WB > WB > Normal)
- Increased moisture %
- Decreased ash %
- Increased collagen %, increased insoluble relative to soluble
- Increased intracellular Na
- Increased intracellular Ca (WB > Normal)
 - Related to greater Ca ATPase? Calcium regulation in muscle altered
 - Damage to muscle, causing leaking of enzymes
 - Greater parvalbumin (calcium binder; Mutryn et al., 2015)
- Lower intracellular creatine kinase (thus, higher CK in serum, Kuttappan et al., 2013)

Soglia et al., 2016; Kuttappan et al., 2013; Yang et al., 2015

Consumer Panel Analysis Open Ended Comments: Dislikes

- **Rubbery (multiple comments)**
- **Funky texture –almost crunchy**
- **Chewy**
- **Gristle**
- **Texture is not exactly tough but more like stretchable, doesn't feel right in the mouth**
- **Does not feel right**
- **Texture was horrible**

Petechial Hemorrhaging in Woody Breast



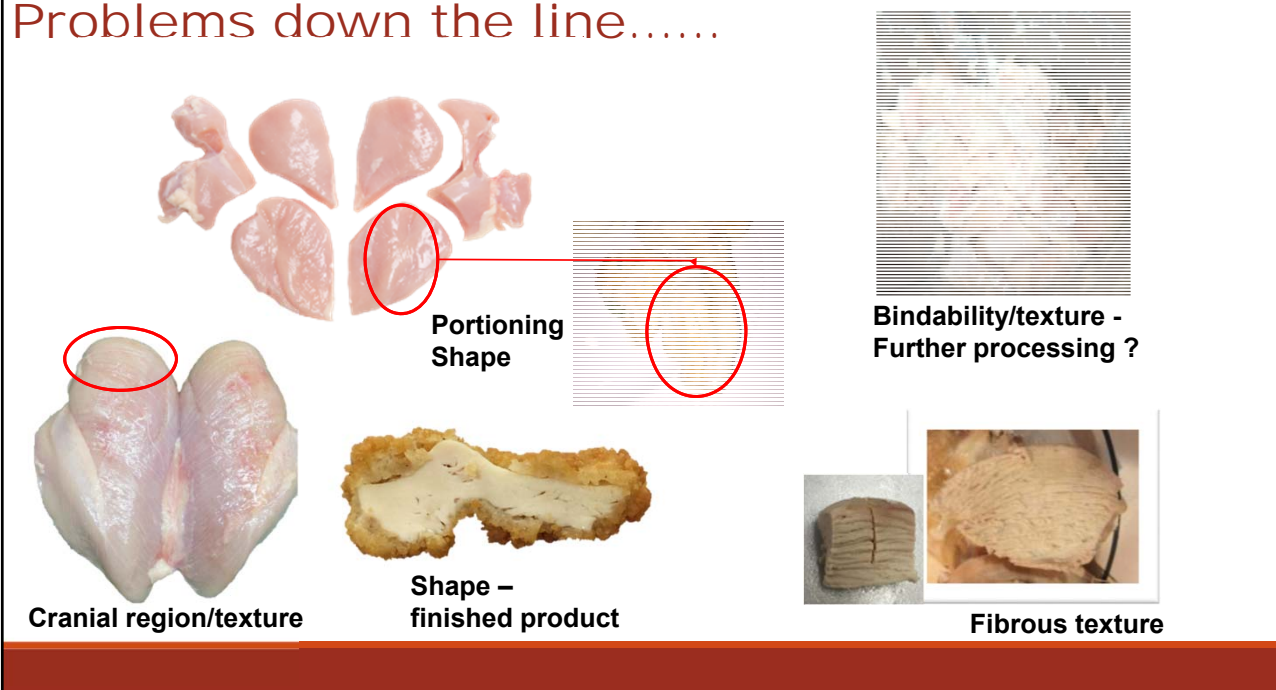
- **Hemorrhaging not always present**
- **Observed with WS and/or WB**
- **FSIS Notice - trimming**

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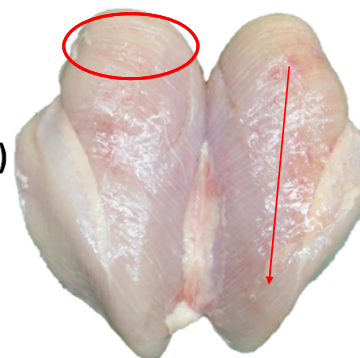
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Problems down the line.....



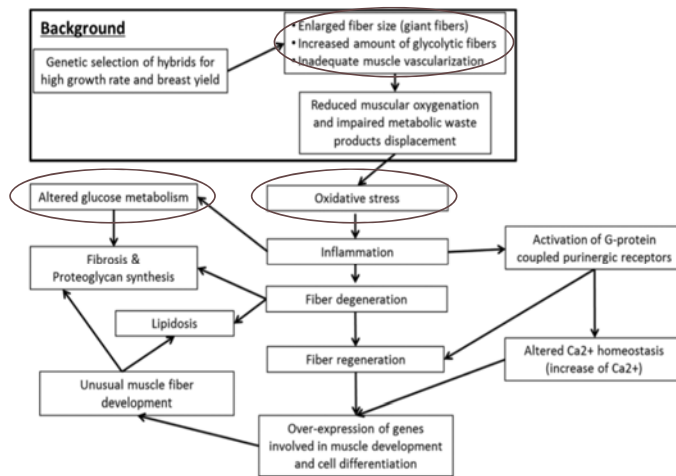
Location Effect and Potential Reasons

- Usually more hardness in:
 - Cranial region (Mallman et al., 2017)
 - Superficial (Zambonelli et al., 2017)
- Hypertrophic myofiber growth (Berri et al. 2007)
- Greater fiber diameter in cranial region than caudal (Clark and Velleman, 2017)
- Reduced spacing endomysial and perimysial spacing, affecting vascularization (Sosnicki and Wilson, 1991; Velleman et al., 2003)



Impact on quality?

Potential Causes



- Enlarged fibers
- Inadequate vascularization
- Oxidative Stress
 - fiber degeneration
- Altered Glucose Metabolism
 - fibrosis

Figure 4. A schematic representation of one of the possible etiologies at the basis of white striping and wooden breast abnormalities.

Zambonelli et al., 2017

How to Manage Woody Breast: Live Production

- **Genetic selection (long term)**
 - Use of palpation of other objective tools for selection
 - Determine biomarker for early detection
 - Less pressure on selection for breast yield?
- **Nutritional modification (short term)**
 - To strategically slow growth?
 - Antioxidants ?
 - Ingredients to support vascularization ?
- **Shorter growout**

Palpation of Live Birds

- Can detect woody breast in live birds
- Correlations between live palpation scores and deboned scores improve as birds increase in age
- $r = 0.53$ to 0.72 from 26 to 54 d of age ($P < 0.05$)
- Early detection via palpation is possible



Mallmann et al., 2017

How to Manage Woody Breast in Short Term: Live Production

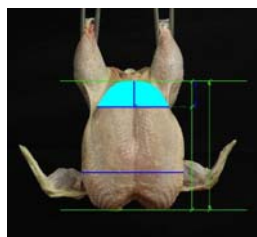
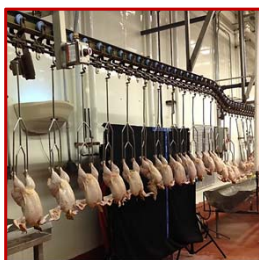
- **Nutritional impacts**
 - Additional energy p g of dig amino acid increased WS/WB compared to increased A.A. with same energy
- **Nutritional modifications**
 - Reduced amino acid and energy density decreased WB
 - Compromises performance
 - Reduced density in starter increased WB
 - Reduced allocation of feed decreased WB
 - Lower body weight
 - Logistically possible?

Schlumbohm et al., 2016
Meloche et al., 2018a,b

How to Manage Woody Breast in Short Term: Plant Perspective

- Processing earlier at lighter weights?
 - A few days = Not big impact
 - Economic impact – yield vs yield accounting WB
- Sort fillets in plants
 - Plant personnel (training required)
 - Track frequency and determine trends
 - Image analysis (USDA Bowker lab, UA Owens lab)
- Divert product into comminuted or similar further processed products with small particle size

Image Analysis for Carcass Sorting



Woody breast severity	Strain	
	Line 1	Line 2
NORM		
MILD		
SEV		

Sun et al., 2017; Caldas-Cueva et al., 2017

patent pending

Predictive Modeling* for Image Features Associated with Woody Breast

- Initial models have ~30% overall misclassification rate
- Less than 1% of normal fillets are classified as severe
- Less than 2% of severe fillets are classified as normal
- Most misclassification is when mild fillets are classified as either normal or severe

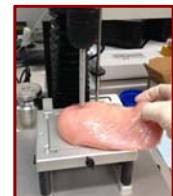
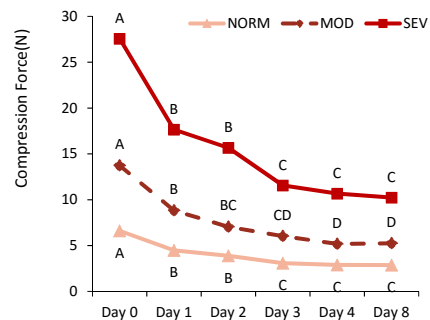
Actual WB_3	Training Predicted Count		
	NOR	MIL	SEV
NOR	283	80	3
MIL	78	141	43
SEV	4	67	143

Actual WB_3	Validation Predicted Count		
	NOR	MIL	SEV
NOR	122	38	4
MIL	27	49	24
SEV	3	30	64

*Final models will depend on automation of calculating carcass feature measurements

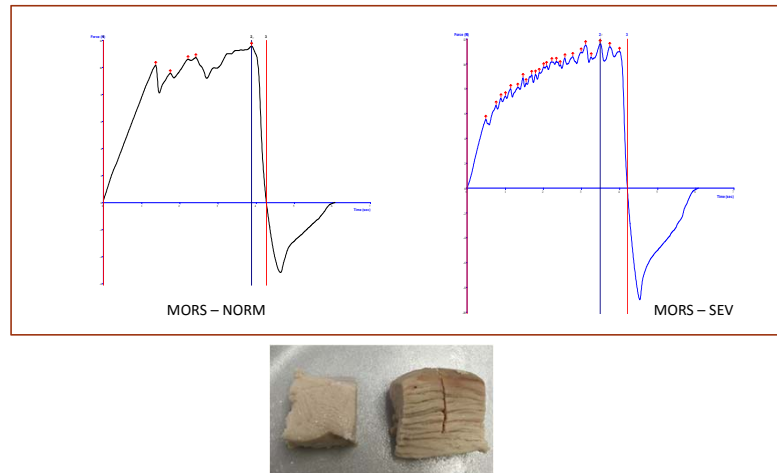
Woody Breast: Hardness Detected by Compression Force (CF)

- CF higher for severe woody fillets compared to moderate or normal.
- CF decreases as fillets are stored especially between 1 and 4 d of storage
- CF and WB category highly correlated ($r_s = 0.79$)



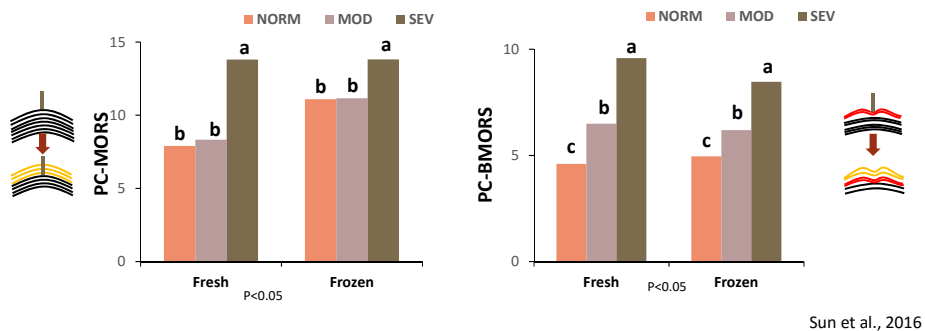
Sun et al., 2018

Peak Counts from Shear Data of Cooked Normal and Woody Breast









Sun et al., 2016

Peak Counts (PC-MORS, PC-BMORS) in Fresh and Frozen Woody Category Fillets



Diverting product: Comminuted Products

- Divert away from whole muscle to lessen effect
- Comminuted Product?
 - Chicken Patties
 - May still has some effect
 - Softer ?
 - Lower springiness
 - Lower cohesiveness
 - Lower chewiness
 - Cook loss higher

Parameters	WB category		
	NOR	MID	SEV
			
C. force (N) (raw filets)	4.29 ± 0.91 ^a	10.03 ± 1.56 ^b	18.56 ± 3.06 ^c
	100% NOR (T1)	100% MID (T6)	100% SEV (T9)
			
Hardness (N)	30.11 ± 3.84 ^a	20.55 ± 3.05 ^b	14.56 ± 1.22 ^c
Cohesiveness	0.78 ± 0.02 ^a	0.74 ± 0.03 ^{ab}	0.71 ± 0.03 ^b
Springiness	0.91 ± 0.03 ^a	0.79 ± 0.05 ^b	0.78 ± 0.06 ^b
Chewiness (N)	21.45 ± 2.39 ^a	12.10 ± 2.31 ^b	8.09 ± 1.10 ^c

Caldas-Cueva and Owens, 2018
Brambila et al., 2017

More Research to Come.....

- Nutritional strategies to manage/reduce WB
- Solutions to product defects in the plant
- Etiology of Woody Breast
 - More “omics” research in the future
- Gut Health?
- Genetic Selection

