LIV Symposium Científico de Avicultura

LEÓN

27 A 29 DE SEPTIEMBRE

DE 2017

Nuevos conocimientos sobre las miopatías de los pollos de engorde

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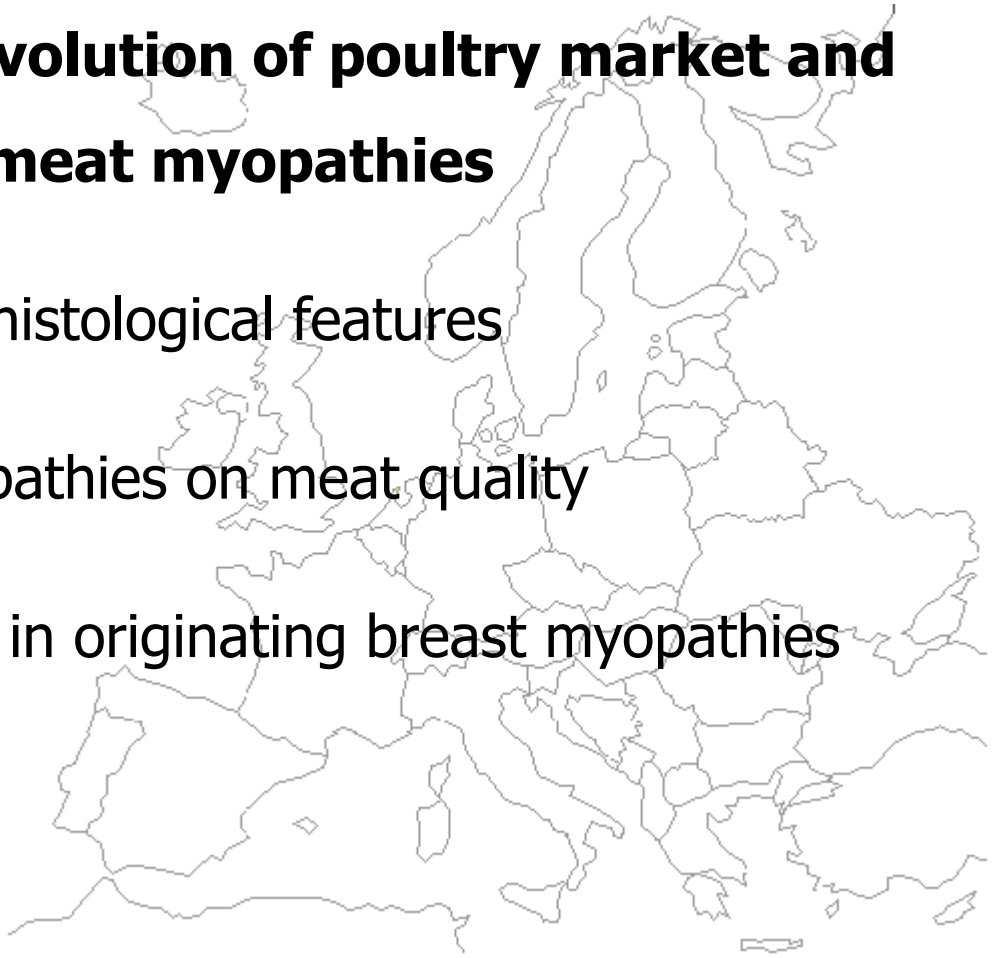
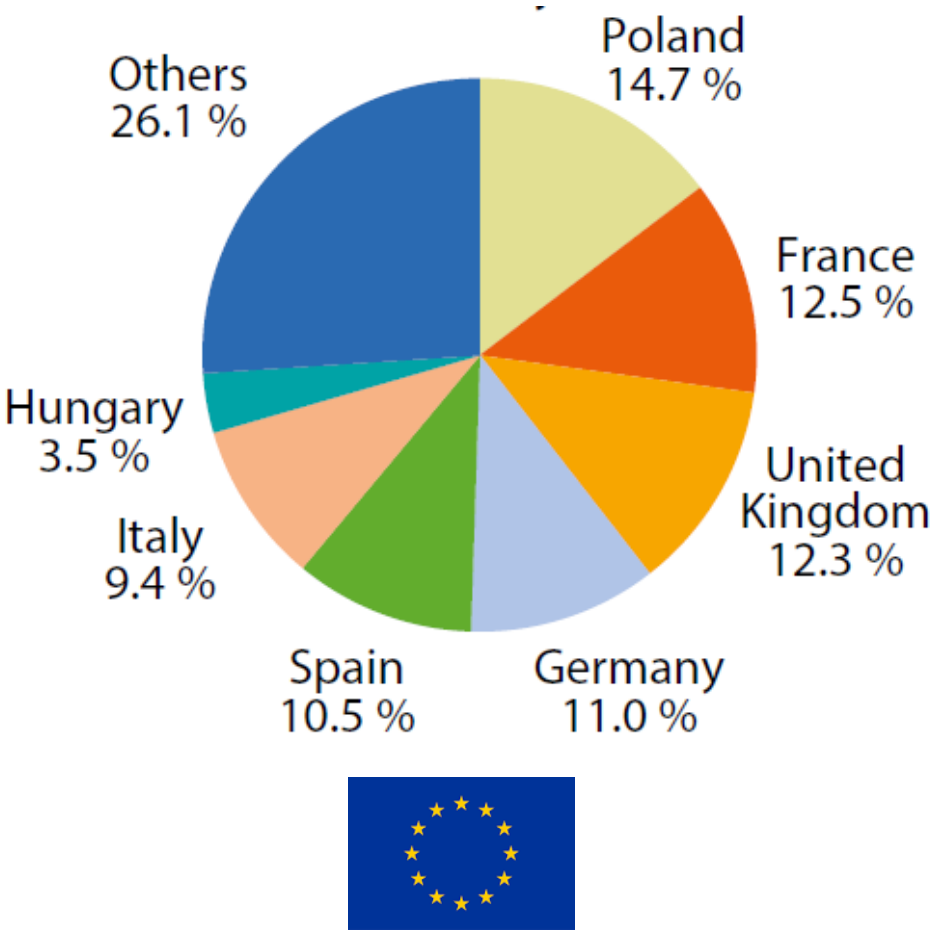
28 Septiembre 2017

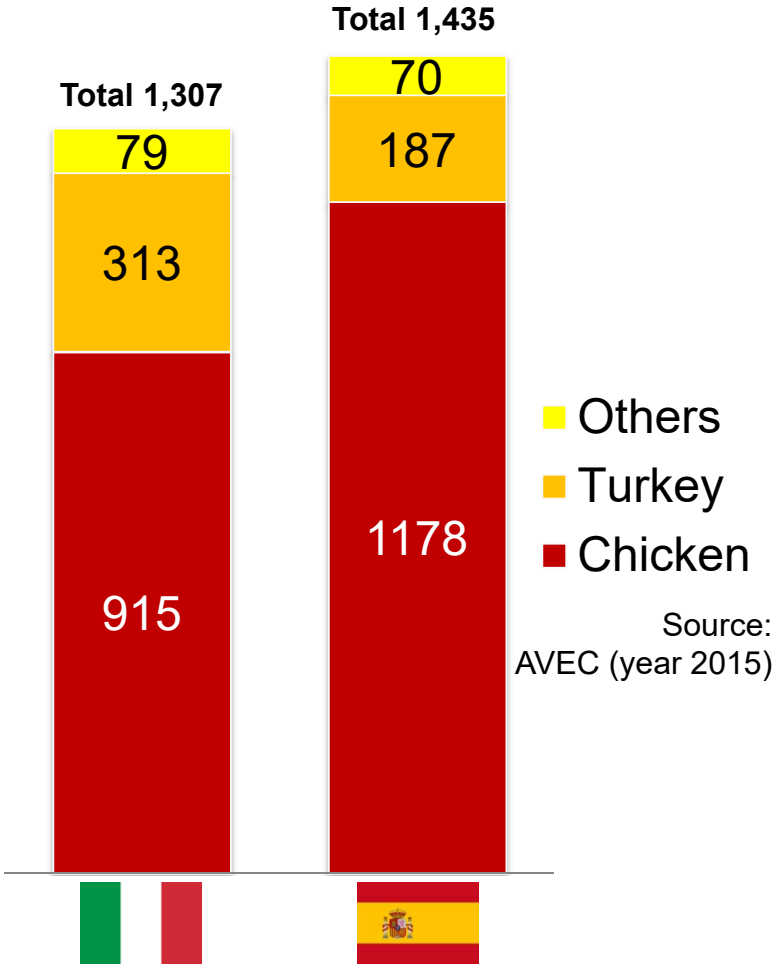
Outline of presentation

1. **Relationship between evolution of poultry market and development of breast meat myopathies**
2. Breast myopathies and its histological features
3. Implications of breast myopathies on meat quality
4. Production factors involved in originating breast myopathies
5. Conclusions



Poultry production in the EU

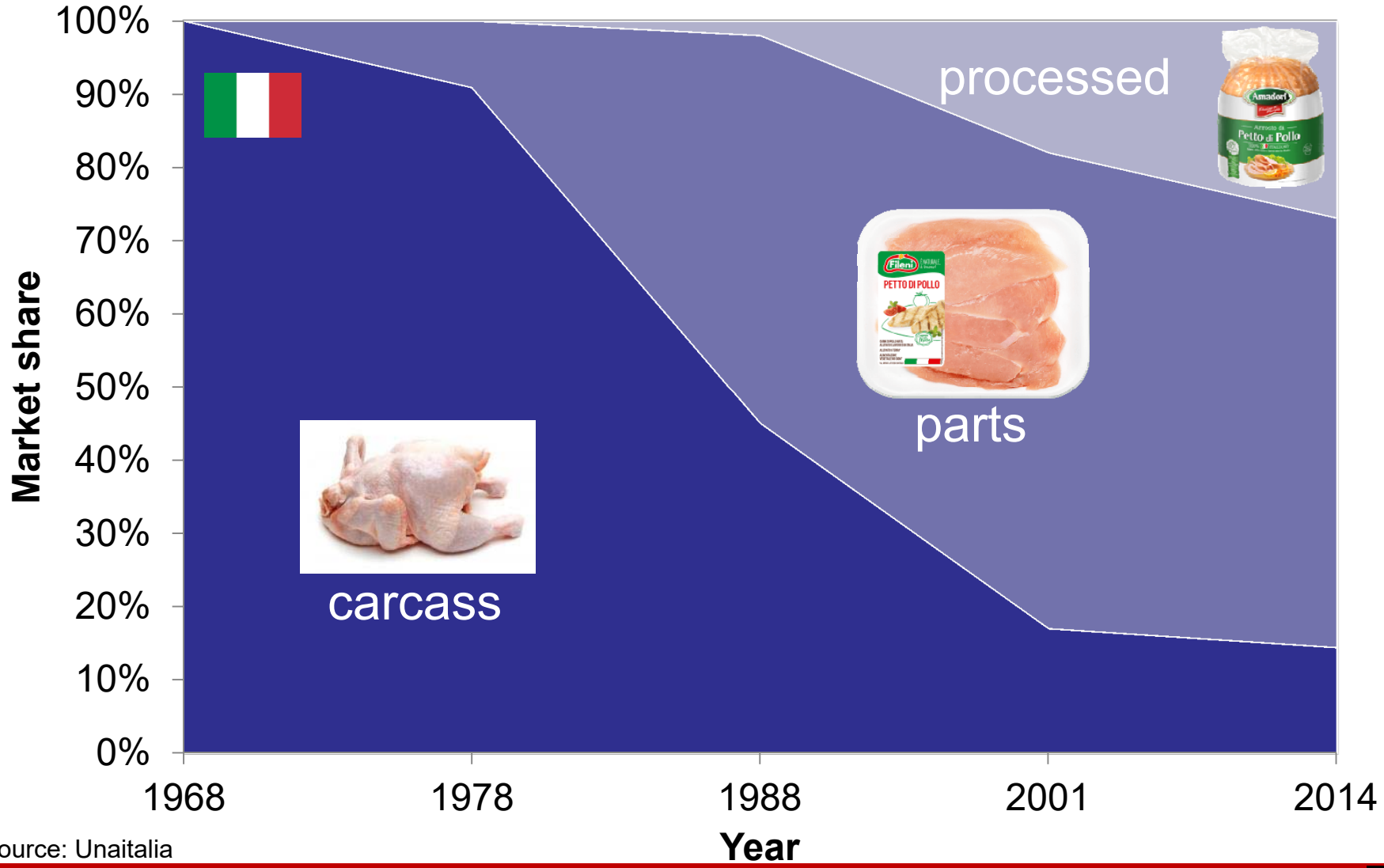




Total production of 14.4 million t
(about 13% of the world production)

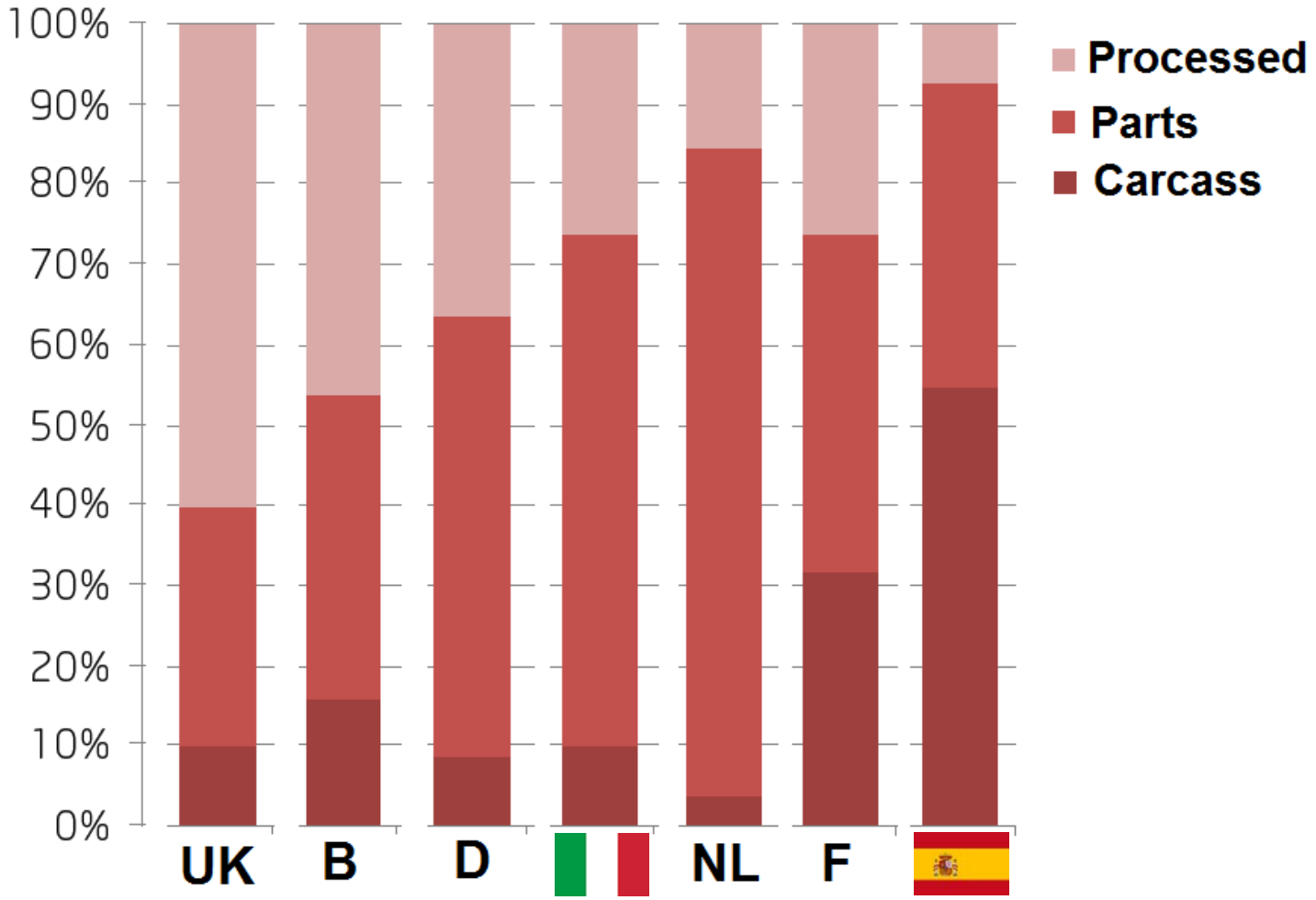
Per-capita consumption (kg)	19.3	31.0
self-sufficiency (%)	107	105

Evolution of broiler market forms in Italy



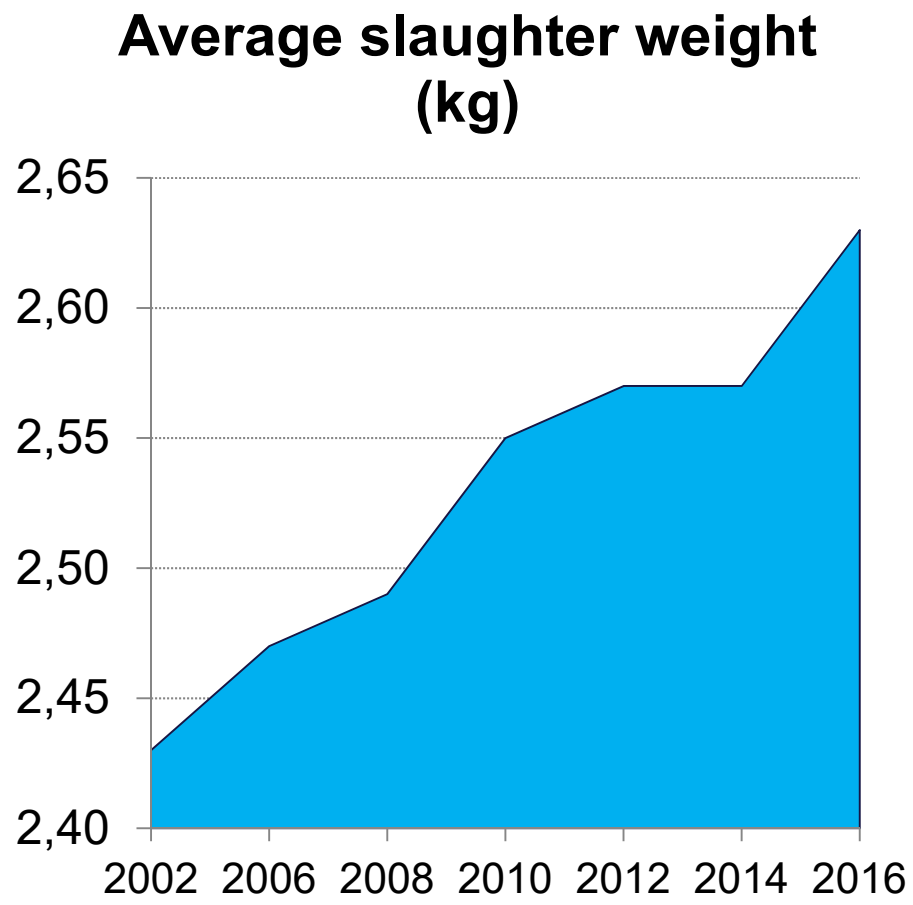
Source: Unaitalia

Broiler market forms in some EU Countries



Source: Les mutations des filières avicoles européennes depuis 2000 (LES ÉTUDES De FranceAgriMer, Dec. 2015)

Evolution of chicken slaughter weight in Italy and improvement of breast yield



Source: Agri-ISTAT

Year	Breast yield (%)
2001[1]	15.8
2007[2]	18.6
2012[2]	21.1
2014[2]	21.5

[1]Havenstein et al. (2003; Poult Sci 82:1509)
[2]Ross 308 Broiler Performance Objectives

Selection for growth rate and breast yield

- Implications on meat quality -

Some changes induced by selection with direct implication on meat quality:

ANATOMY
- unbalanced body conformation
- increased skeletal and vascular fragility

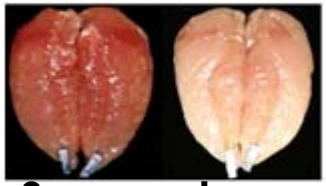
BEHAVIOUR
- poor mobility

MUSCLE TISSUE
- muscle hypertrophy
- accentuation of glycolytic metabolism
- reduced vascularisation

PHYSIOLOGY
- reduced thermoregulatory capacity

1- green muscle disease

2- extreme colour (DFD, PSE-like)



3- emerging myopathies

Outline of presentation

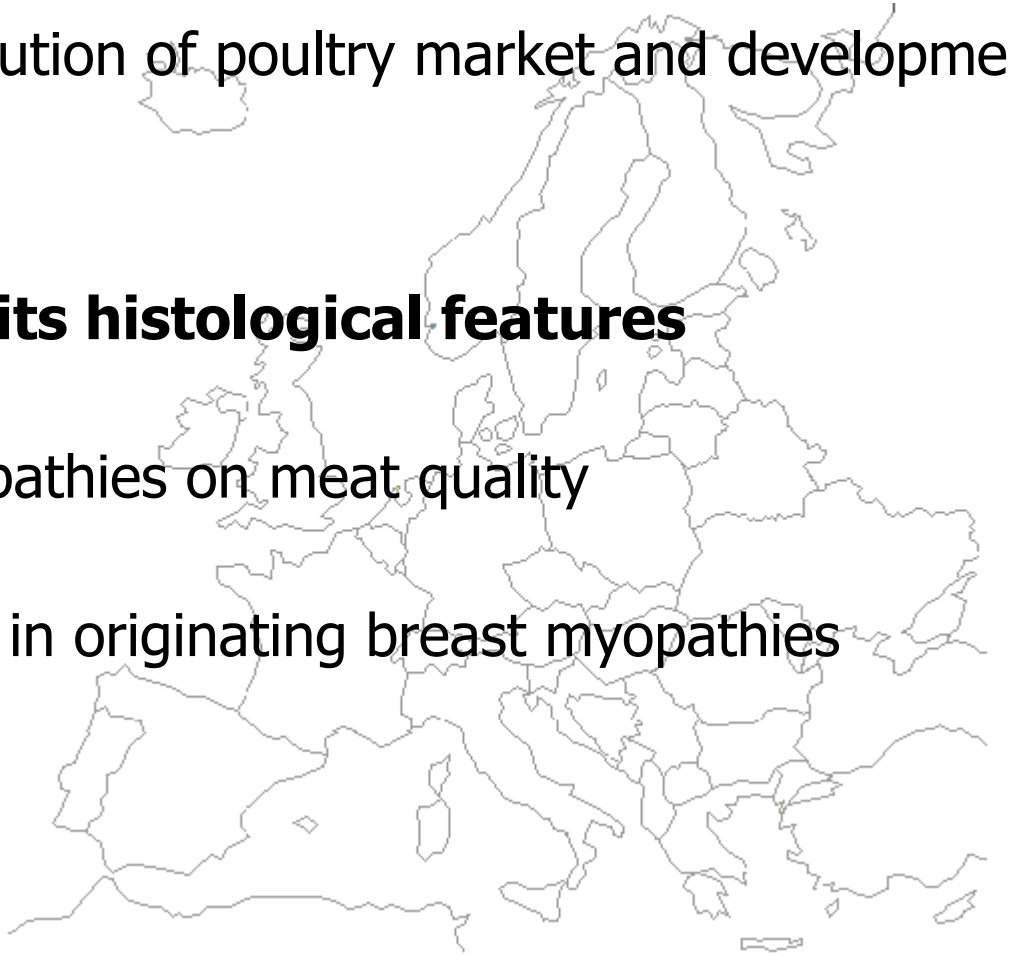
1. Relationship between evolution of poultry market and development of breast meat myopathies

2. Breast myopathies and its histological features

3. Implications of breast myopathies on meat quality

4. Production factors involved in originating breast myopathies

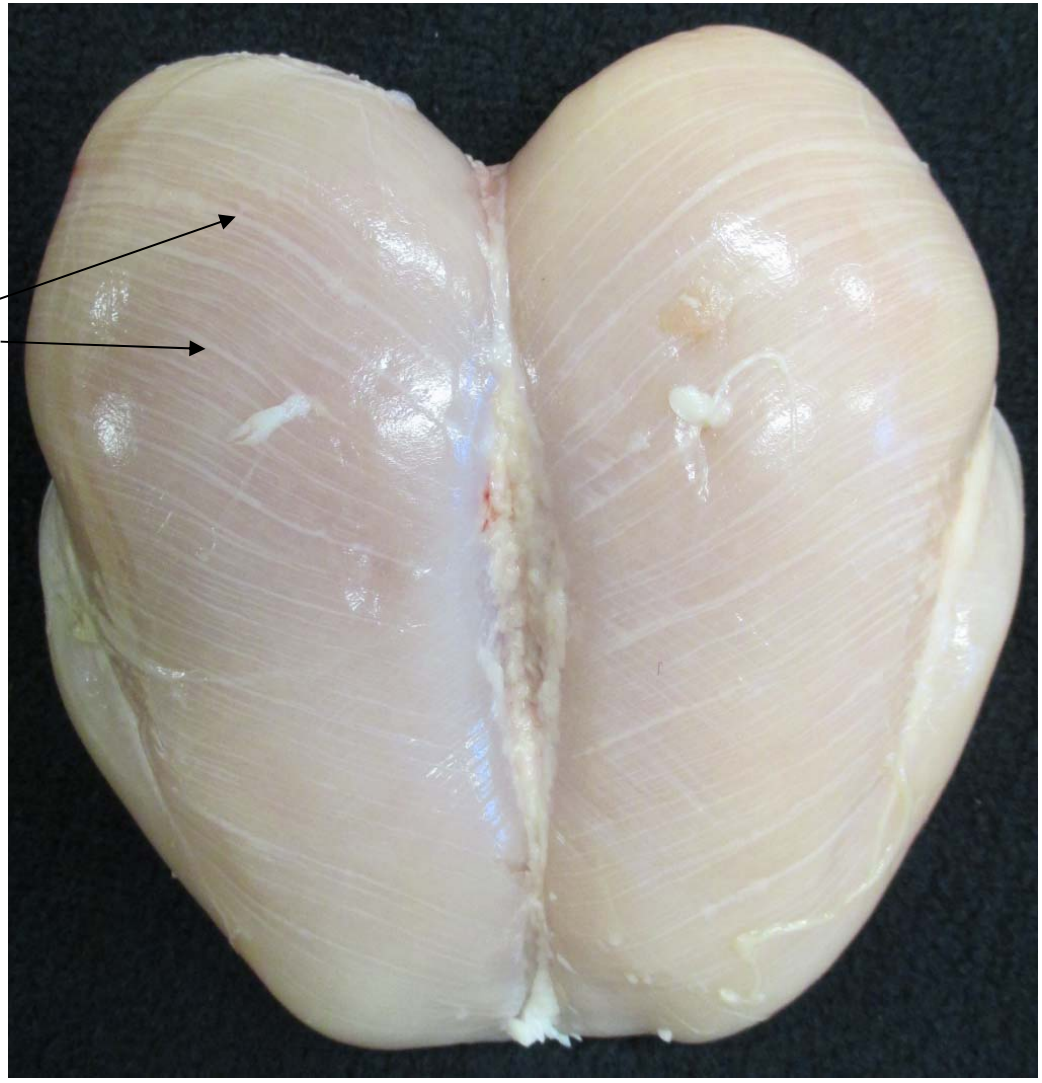
5. Conclusions



Breast myopathies

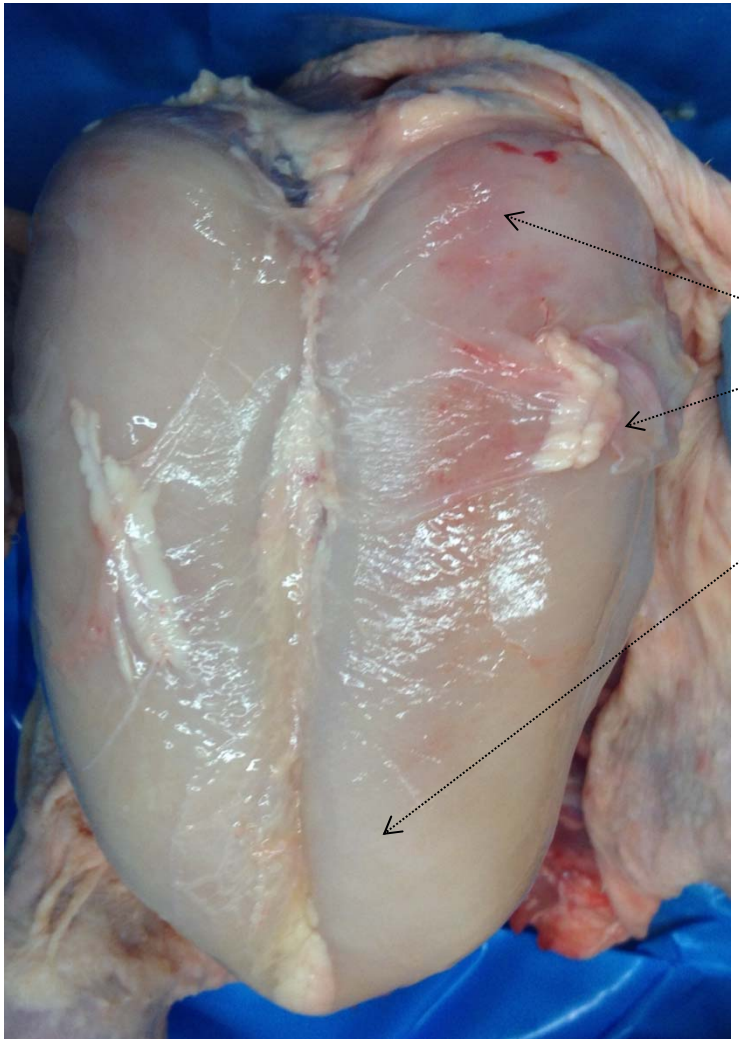
- White Striping -

Abnormal white striations parallel to muscle fibres on surface of breast fillets

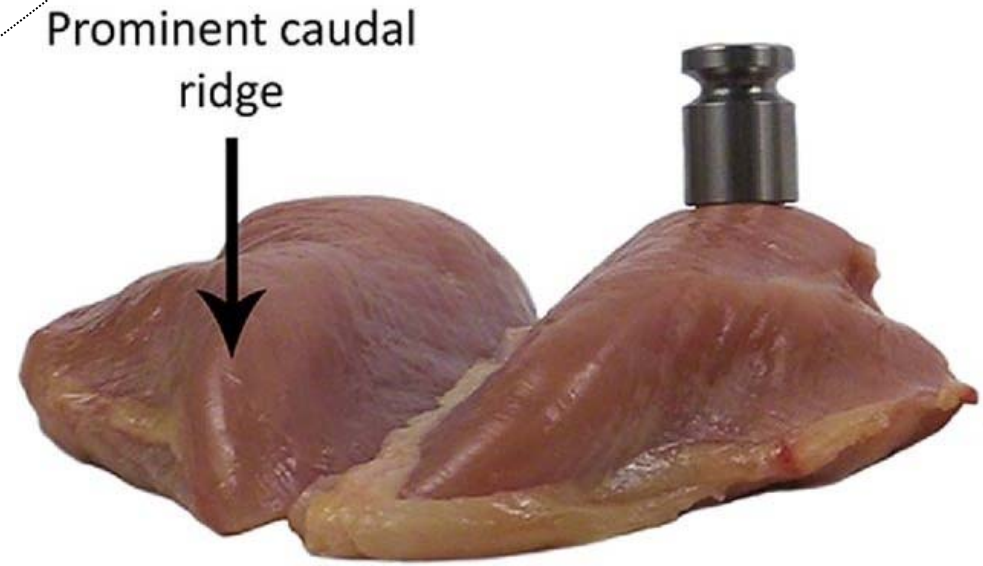


Breast myopathies

- Wooden breast -



Macroscopic visible ***hard, prominent caudal ridge,***
often associated with ***paleness,***
superficial viscous liquid *and* ***petachiae.***



Kuttappan et al. (2016; Poult Sci 11:2724)

Breast myopathies
- Occurrence levels -

Incidence of broiler breast myopathies at 2 different ages and its impact on selected raw meat quality parameters

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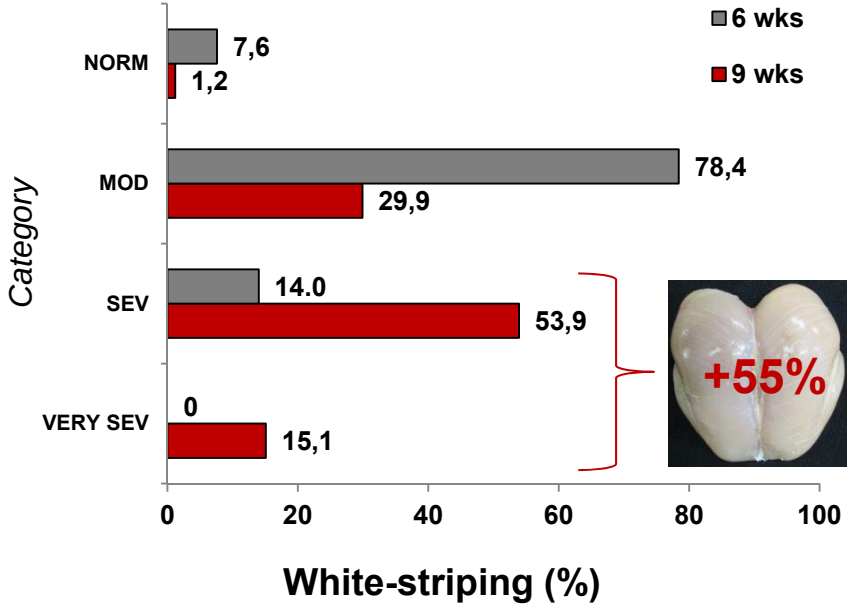
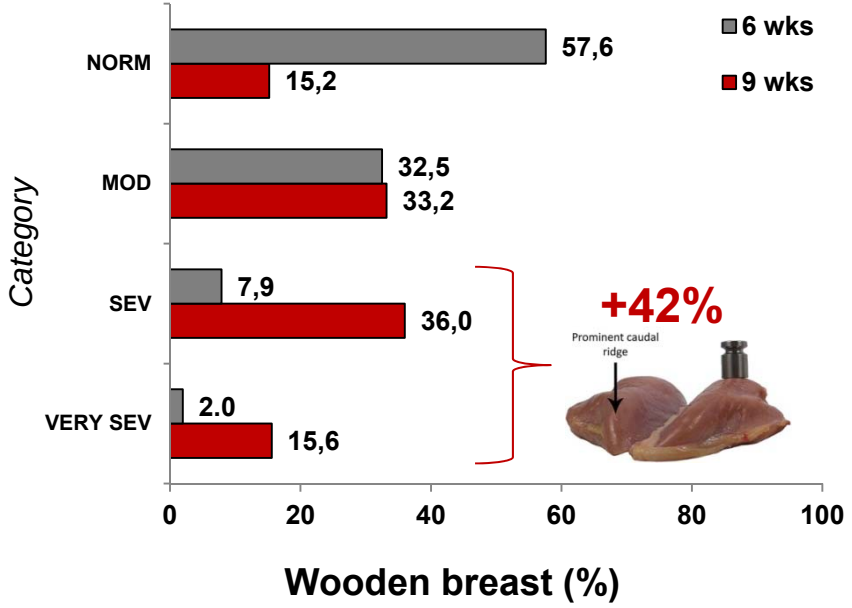
[*]*Novus International Inc., St. Charles, Missouri; and* [†]*Department of Poultry Science, University of Arkansas, Fayetteville, Arkansas*

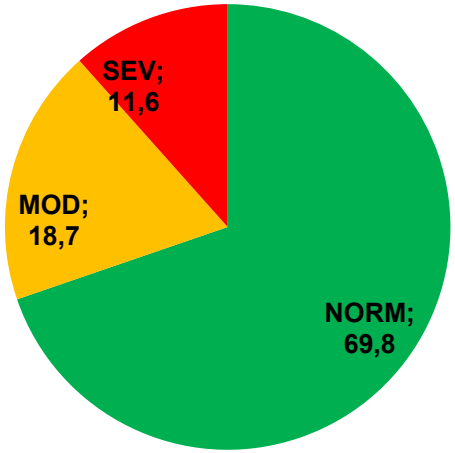
2017 Poultry Science 96:3005–3009
http://dx.doi.org/10.3382/ps/pex072





Breast myopathies

- Spaghetti meat -

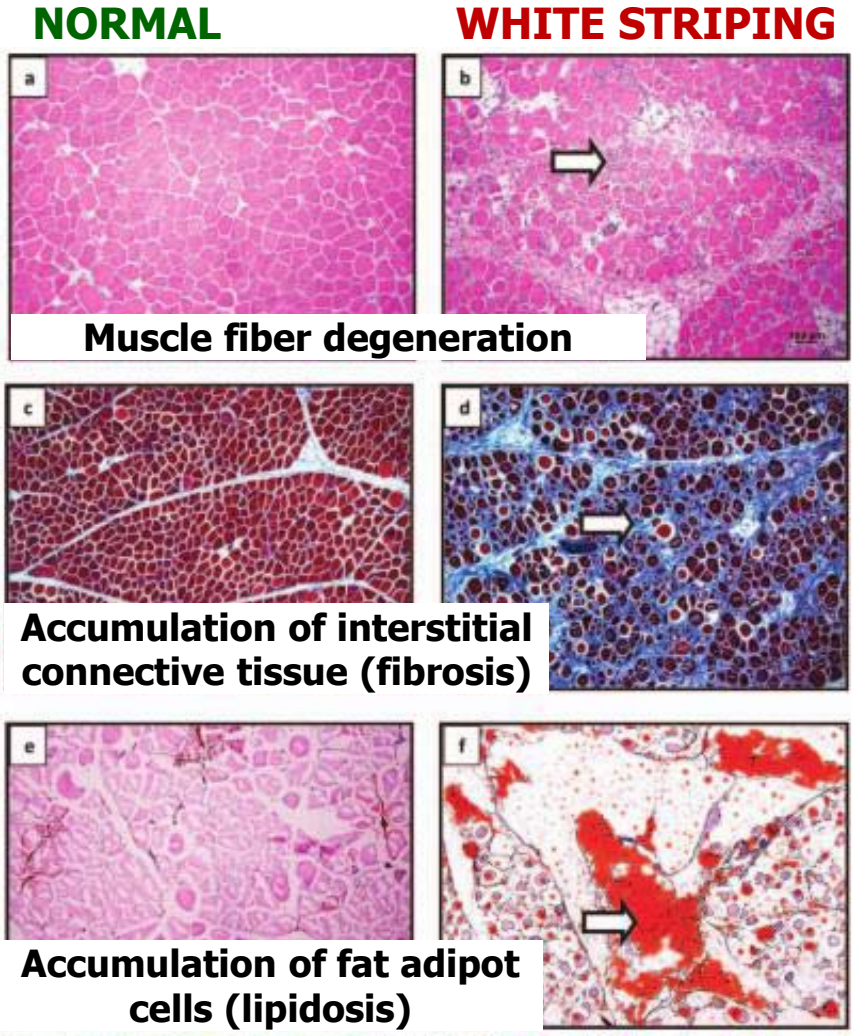


Year 2014
Flocks n. 79
Age 41-57d
Average wt. 3.0kg
Brest filltes n. 16,000

Especially in the cranial section of the breast, there is a loss of integrity and a separation of fibre bundles which seem like spaghetti.

Histology traits of breast myopathies

- White striping -

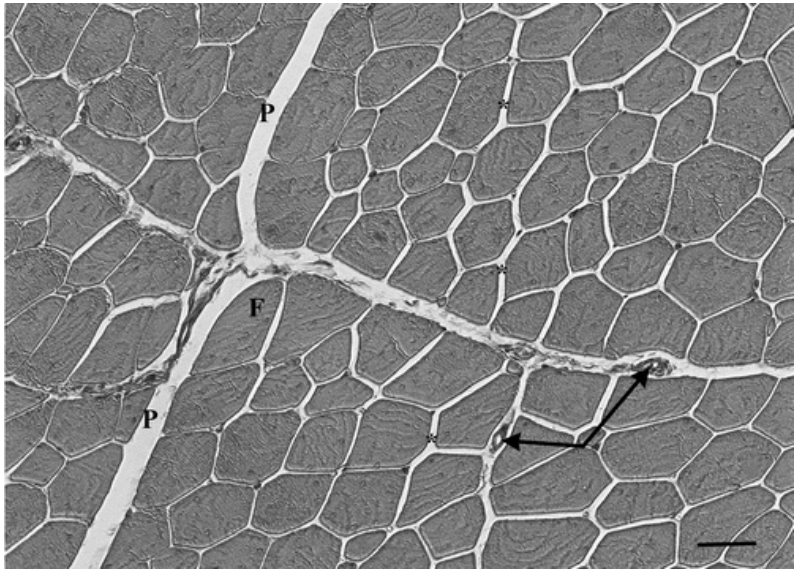


Kuttapan *et al., 2013, Poult Sci 92:331*

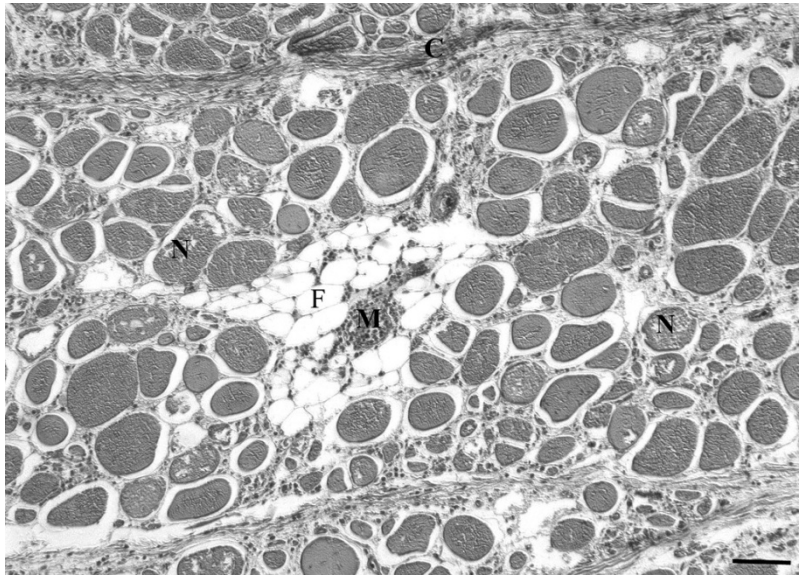
Histology traits of breast myopathies

- Wooden breast -

NORMAL



WOODEN BREAST



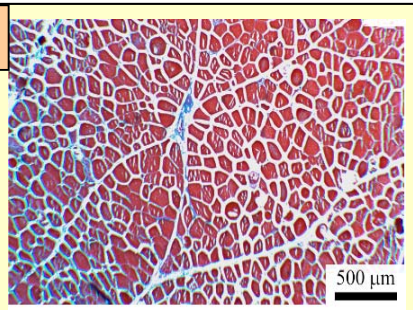
- Extensive <u>necrosis</u> of existing muscle fibers and <u>invasion</u> of <u>macrophages</u>.

- <u>Fibrosis</u>: muscle is replaced with connective tissue, and in the case of wooden breast the collagen is extensively cross-linked, which will result in the wood-like texture of the muscle.

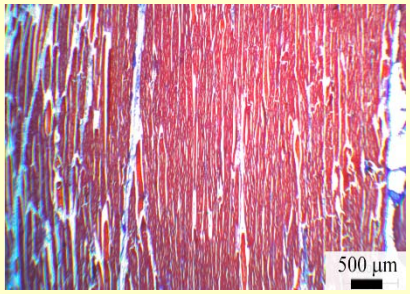
Histology traits of breast myopathies

- Spaghetti meat -

NORM

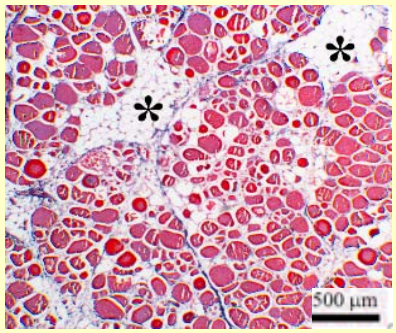


Transversal section

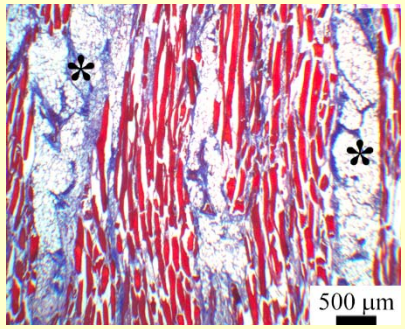


Longitudinal section

WHITE STRIPING



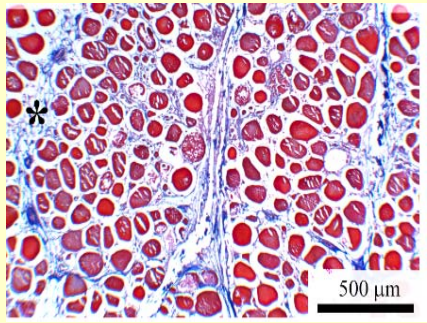
Transversal section



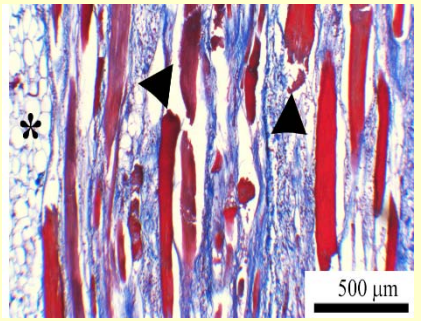
Longitudinal section

Increased deposition of adipocytes within the connective tissue (lipidosis) and fat infiltrations attaining the amount of fibrillar components.

SPAGHETTI MEAT



Transversal section



Longitudinal section

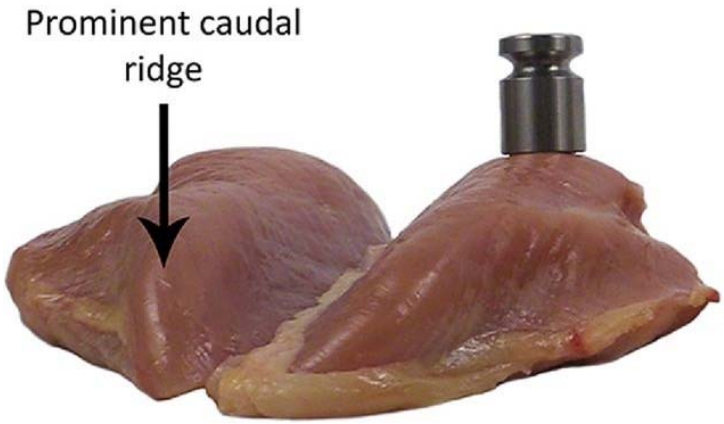
Progressive rarefaction of the endo- and peri-mysial connective tissue leading to muscle fibers detachment from each other. Thin and split fibers surrounded by loose (immature) connective tissue and abundant inflammatory cells infiltrations.

Baldi et al. 2017, Anim doi: 10.1017/S1751731117001069

Histology traits of breast myopathies

- Summary -

White-striations are associated with ***moderate*** histopathological lesions and deposition of mainly fat (**lipidosis**)



Kuttapan et al. (2016; Poult Sci:ps/pew216)

Wooden breast is associated with ***severe*** histopathological lesions and deposition of mainly collagen (**fibrosis**)

Spaghetti meat is associated with ***severe*** histopathological lesions with **disappearing of fibre bundle architecture**

Histology traits of breast myopathies

- Latest knowledge -

Onset of white striping and progression into wooden breast as defined by myopathic changes underlying *Pectoralis major* growth. Estimation of growth parameters as predictors for stage of myopathy progression

Jacqueline Reedy Griffin, Luis Moraes, Macdonald Wick and Michael Snell Lilburn

Department of Animal Sciences, The Ohio State University, Columbus, OH, USA

AVIAN PATHOLOGY, 2017
https://doi.org/10.1080/03079457.2017.1356908

Effect of age on the occurrence of muscle fiber degeneration associated with myopathies in broiler chickens submitted to feed restriction

G. Radaelli,* A. Piccirillo,* M. Birolo,* D. Bertotto,* F. Gratta,† C. Ballarin,* M. Vascellari,‡ G. Xiccato,† and A. Trocino*,1

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2017 Poultry Science 96:309–319
http://dx.doi.org/10.3382/ps/pew270

Histology, composition, and quality traits of chicken *Pectoralis major* muscle affected by wooden breast abnormality

F. Soglia,* S. Mudalal,† E. Babini,* M. Di Nunzio,* M. Mazzoni,‡ F. Sirri,* C. Cavani,* and M. Petracci*,1

*Department of Agricultural and Food Sciences, Alma Mater Studiorum - University of Bologna, 47521 Cesena, Italy; †Department of Nutrition and Food Technology, Faculty of Agriculture and Veterinary Medicine, An-Najah National University, P.O. Box 7, Nablus, Palestine; and ‡Department of Veterinary Medical Sciences, Alma Mater Studiorum - University of Bologna, 40064 Ozzano dell'Emilia (BO), Italy

2016 Poultry Science 95:651–659
http://dx.doi.org/10.3382/ps/pev353

Spatial influence on breast muscle morphological structure, myofiber size, and gene expression associated with the wooden breast myopathy in broilers

D. L. Clark and S. G. Velleman[1]

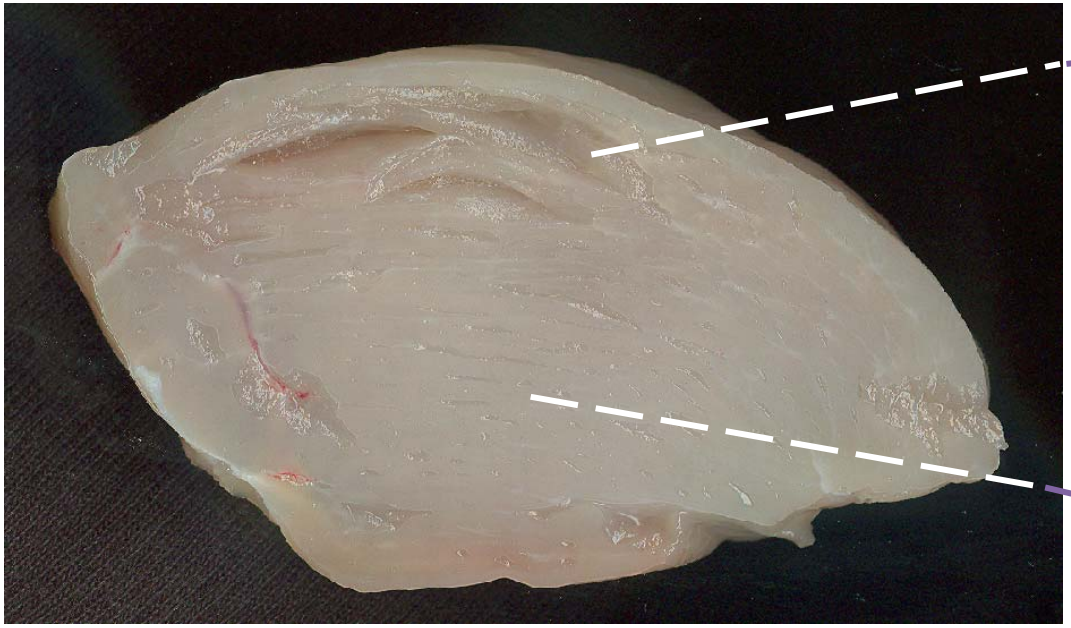
Department of Animal Sciences, The Ohio State University/Ohio Agricultural Research and Development Center, Wooster 44691

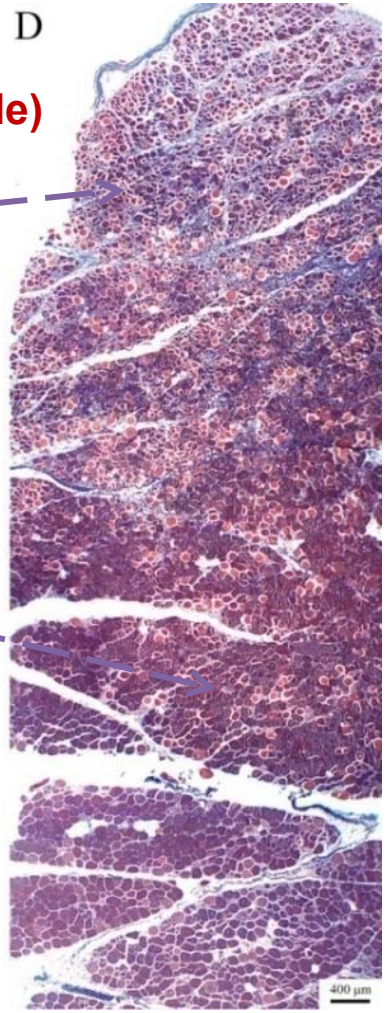
2017 Poultry Science 95:2930–2945
http://dx.doi.org/10.3382/ps/pew243

Histology traits of breast myopathies

- Spatial differences through breast muscle -

Section of cranial part of breast fillet (*P. major* muscle)



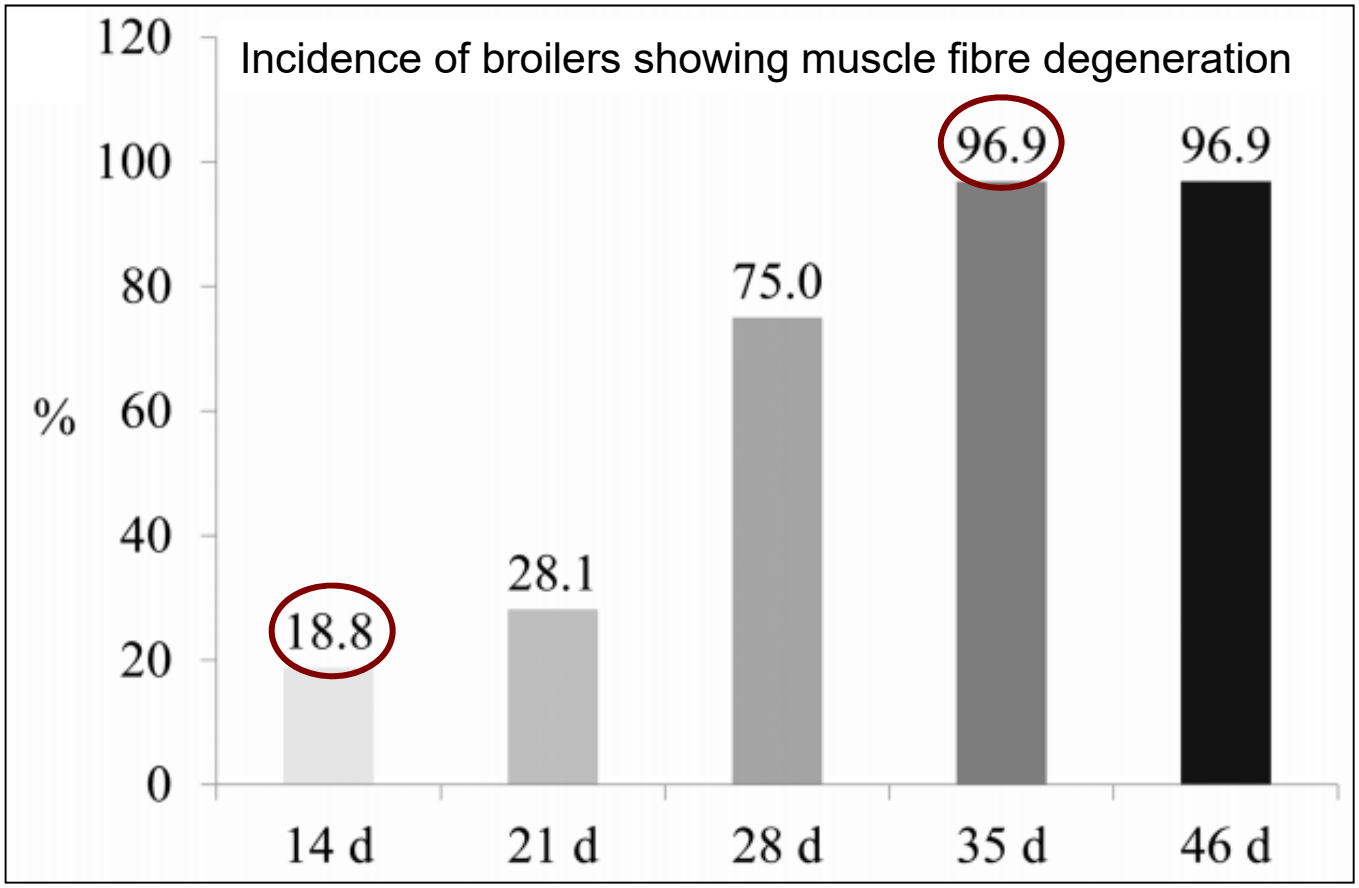


Severe histopathological lesions

Moderate histopathological lesions

Histology traits of breast myopathies

- Evolution of muscle fibre degeneration -



Radaelli *et al*. 2017, Poult Sci 96:309

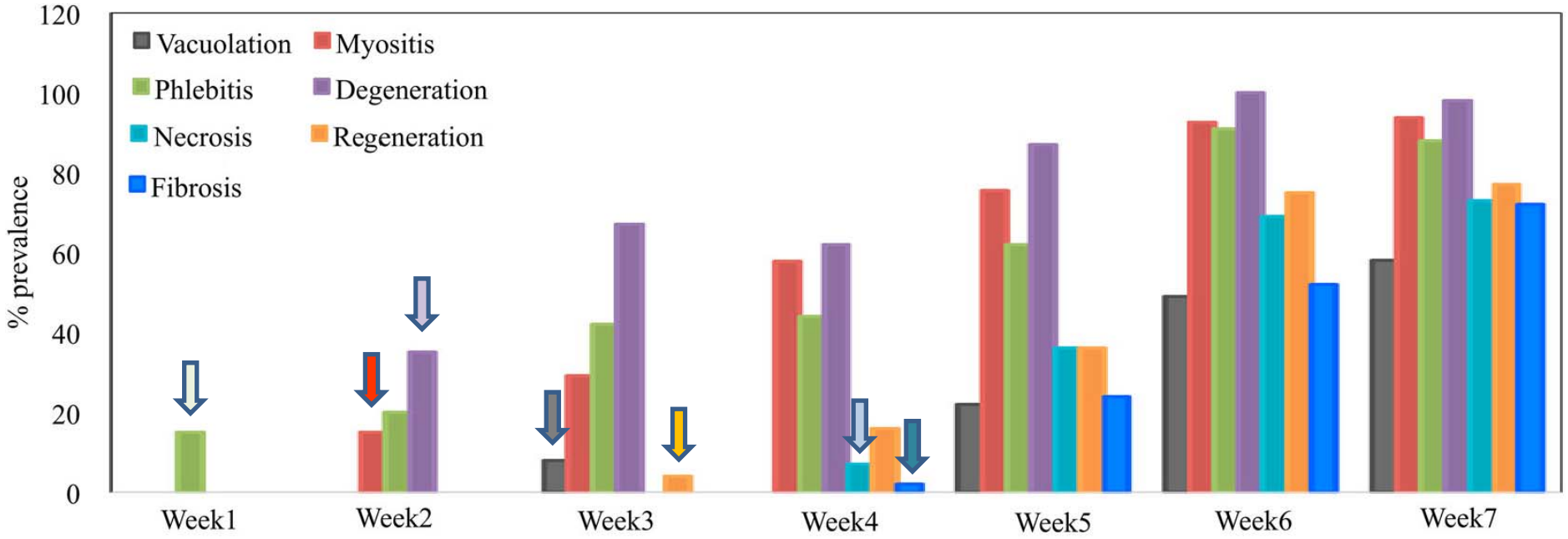
Histology traits of breast myopathies

- Phlebitis is the first event that promotes muscle fibre degeneration -

Evidence and role of phlebitis and lipid infiltration in the onset and pathogenesis of Wooden Breast Disease in modern broiler chickens

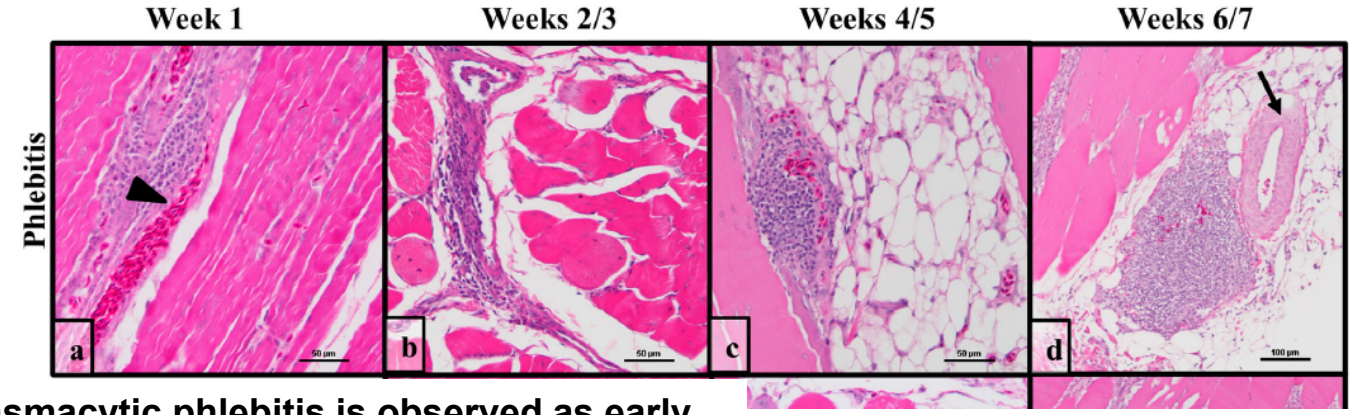
Michael B. Papah, Erin M. Brannick, Carl J. Schmidt and Behnam Abasht
Department of Animal and Food Sciences, University of Delaware, Newark, DE, USA

AVIAN PATHOLOGY, 2017
https://doi.org/10.1080/03079457.2017.1339346



Histology traits of breast myopathies

- Phlebitis is the first event that promotes muscle fibre degeneration -



Lymphoplasmacytic phlebitis is observed as early as 1 week of age, beginning as occasional eccentr mural lymphoid infiltrates (arrowhead (a)) with secondary venous congestion and oedema (a) and progressing to complete venous occlusion (b–d), while adjacent arterial vasculature is unaffected (dark arrow: (d))

Attempted regeneration and repair is evident by myotube formation with nuclear rowing by Week 3 (R, (h)) and early fibrosis from Week 4 with progression to scarring ((i), centre) in pectoral muscle by market age (5-7 weeks of age)

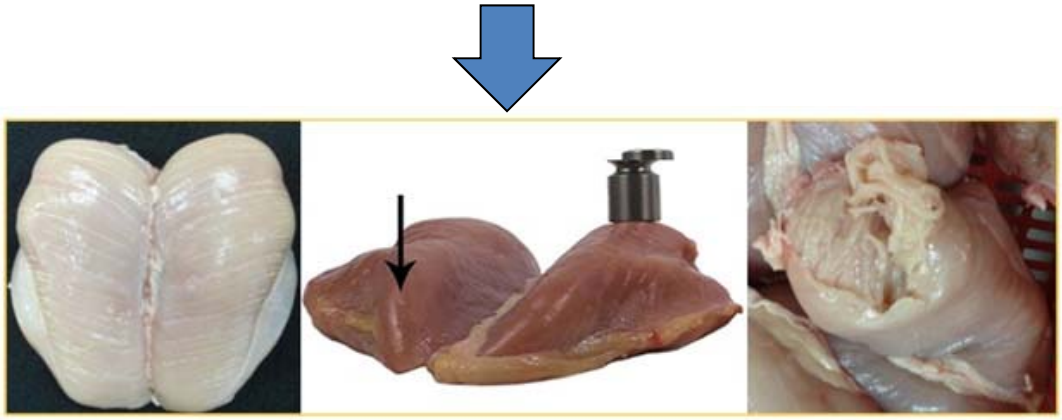
Myofibre degeneration and necrosis characterized by segmental myofibrillar disruption ((e), white arrows), myofibre rounding and hypereosinophilia ((f), white *), hyalinization ((f), dark *), fibre splitting ((f), broken arrow) and vacuolation (g) is observed from 2 weeks of age with concurrent development of heterophilic infiltrates within and around affected myofibres (myositis) (g). Myofibre degeneration and myositis progresses in lesion distribution and severity over time with acute degenerative changes observed alongside reparative lesions (multifocal multiphasic myopathy, (g)).

Mechanisms involved in breast myopathy development

Reduced vascularisation (i.e. reduction number of capillaries and phlebitis) may:

- promote fibre necrosis due to anoxic conditions and prolonged accumulation of toxic waste products (i.e. lactic acid);

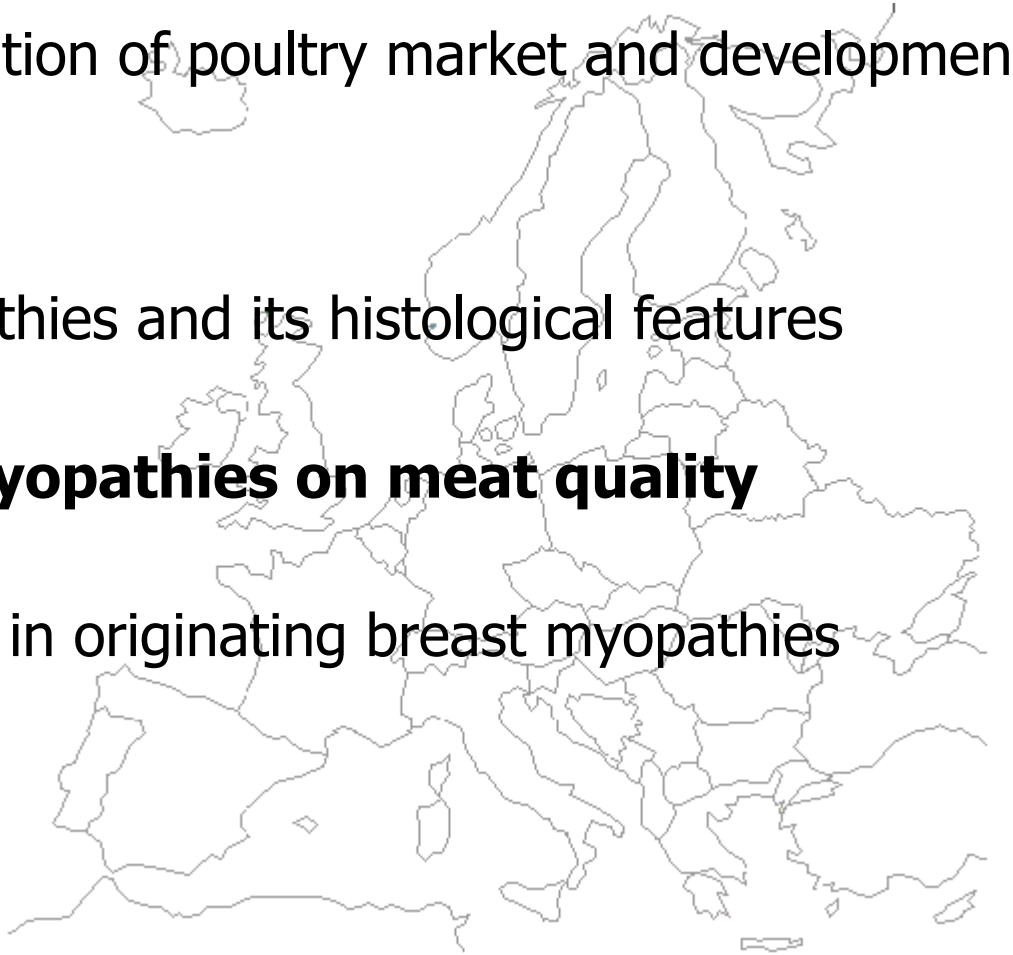
- suppress regeneration processes (satellite cell-mediated).



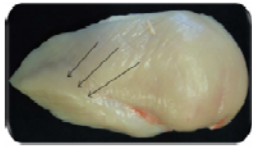
Petracci et al., 2015, World Poult Sci J 71:363; Clark & Velleman, 2017, Poult Sci 95:2930

Outline of presentation

1. Relationship between evolution of poultry market and development of breast meat myopathies
2. Main current breast myopathies and its histological features
3. **Implication of breast myopathies on meat quality**
4. Production factors involved in originating breast myopathies
5. Conclusions

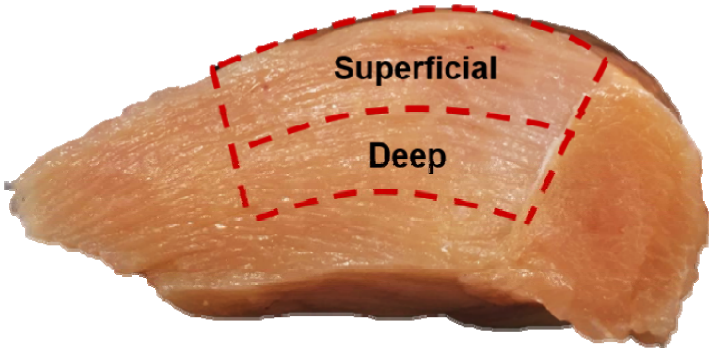


Implications on raw meat composition

Parameter	NORM	WS	WB	SM
				
Moisture	o	o	+	+
Protein	o	-	--	-/--
Lipids	o	++	o/+	o/+
Collagen	o	o/+	+	o/+
Ash	o	o	-	-

o = normal; ++ = much higher; + = higher; - = lower; -- = much lower

Implications on raw meat composition



On 48 samples/position/group:

- **Moisture**
- **Protein**
- **Lipid**
- **Ash**
- **Collagen**

Implications of white striping and spaghetti meat abnormalities on meat quality and histological features in broilers

animal

G. Baldi[1], F. Soglia[1], M. Mazzoni[2], F. Sirri[1], L. Canonico[1], E. Babini[1], L. Laghi[1], C. Cavani[1] and M. Petracci[1†]

[1]Department of Agricultural and Food Sciences, Alma Mater Studiorum – University of Bologna, 47521 Cesena (FC), Italy; [2]Department of Veterinary Medical Sciences, Alma Mater Studiorum – University of Bologna, 40064 Ozzano dell'Emilia (BO), Italy

Animal, page 1 of 10 © The Animal Consortium 2017
doi:10.1017/S1751731117001069

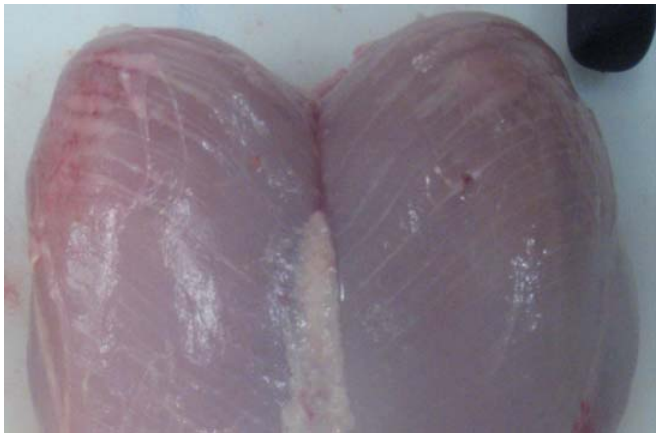
Implications on raw meat composition

Parameter	Position	Experimental Group			
		NORM	WS	SM	WS/SM
Moisture (%)	superficial	75.0^{bc}	75.2^{b}	76.3^{a}	76.1^{a}
	deep	74.7^{c}	74.4^{c}	75.2^{b}	75.1^{bc}
Protein (%)	superficial	23.6^{ab}	22.5^{cd}	21.9^{d}	21.9^{d}
	deep	24.3^{a}	23.5^{b}	23.5^{b}	23.4^{bc}
Lipid (%)	superficial	1.53^{d}	2.47^{a}	1.82^{bcd}	2.40^{a}
	deep	1.58^{cd}	2.05^{ab}	1.59^{cd}	1.93^{bc}
Ash (%)	superficial	1.20^{a}	1.15^{ab}	1.10^{b}	1.10^{b}
	deep	1.21^{a}	1.16^{ab}	1.16^{ab}	1.19^{a}
Collagen (%)	superficial	0.86^{ab}	0.92^{a}	0.94^{a}	0.92^{a}
	deep	0.82^{b}	0.84^{b}	0.83^{b}	0.84^{b}

a-d $P<0.05$

Baldi et al. 2017, Anim doi: 10.1017/S1751731117001069

Implications on technological properties of the meat



Severe WS and/or WB

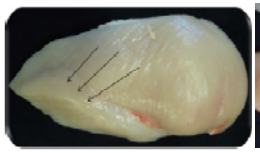
Poor appearance

Cut-up retail (whole and sliced)

Technological properties ????

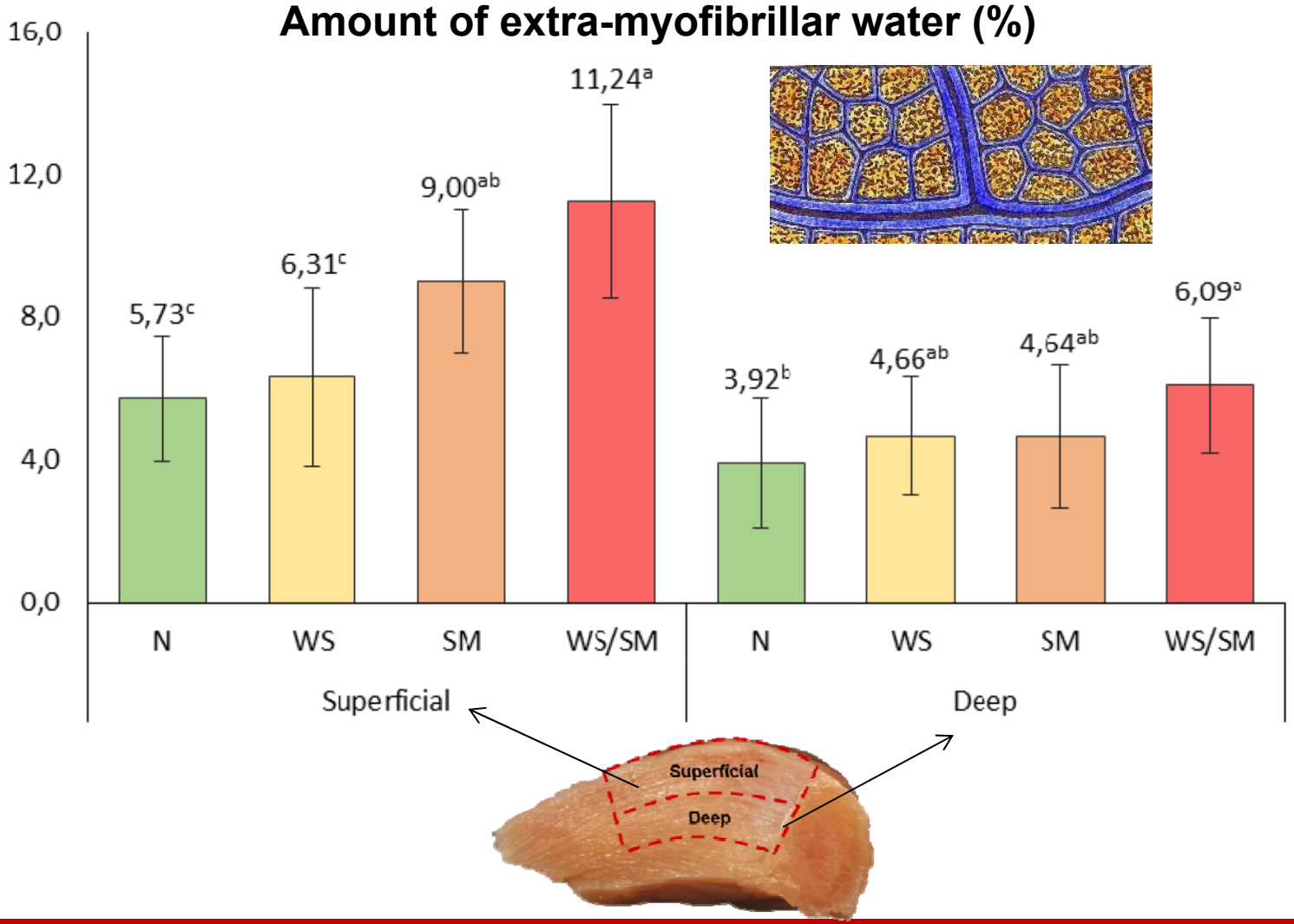
Incorporation as ingredient into processed products

Implications on technological properties of the meat

Parameter	NORM	WS	WB	Spaghetti
				
pH	o	+	++	+
Water holding capacity – drip loss	o	o/-	o/-	o/-
Water holding capacity – cook loss	o	-	--	--
Water binding capacity	o	-	--	--
Tenderness	o	o	-	o

o = normal; ++ = much higher; + = higher; - = lower; -- = much lower

Implications on technological properties of the meat



Baldi et al. 2017, Anim doi: 10.1017/S1751731117001069

Implications on technological properties of the meat

A comparative study of functional properties of normal and wooden breast broiler chicken meat with NaCl addition[1]

Tong Xing,[2] Xue Zhao, Minyi Han, Linlin Cai, Shaolin Deng, Guanghong Zhou, and Xinglian Xu

Key Laboratory of Meat Processing and Quality Control, Ministry of Education, Synergetic Innovation Center of Food Safety and Nutrition, College of Food Science and Technology, Nanjing Agricultural University, Nanjing 210095, China

2017 Poultry Science 96:3473–3481
http://dx.doi.org/10.3382/ps/pex116

Descriptive texture analyses of cooked patties made of chicken breast with the woody breast condition[1]

G. Sanchez Brambila, Debolina Chatterjee, B. Bowker, and H. Zhuang[2]

USDA-Agricultural Research Service, U.S. National Poultry Research Center, 950 College Station Road, Athens, GA 30605–5677

2017 Poultry Science 96:3489–3494
http://dx.doi.org/10.3382/ps/pex118

Implications on technological properties of the meat

	FILLETS		PATTIES	
Attributes:	*Normal*	*Woody*	*Normal*	*Woody*
Springiness	$8.6^{b} \pm 1.9$	$10.0^{a} \pm 1.6$	$8.0^{a} \pm 1.9$	$7.3^{b} \pm 2.2$
Hardness	$6.2^{b} \pm 0.9$	$6.9^{a} \pm 1.2$	5.1 ± 0.8	5.0 ± 0.8
Juiciness	3.3 ± 1.6	3.0 ± 1.2	2.3 ± 1.1	2.5 ± 1.3
Cohesiveness of mass	7.0 ± 1.1	7.0 ± 1.2	4.8 ± 1.4	4.5 ± 1.4
Bolus/wad size	7.4 ± 1.5	7.5 ± 1.0	6.5 ± 1.5	6.5 ± 1.4
Wetness of wad	6.7 ± 1.6	7.1 ± 1.4	5.0 ± 1.9	5.4 ± 1.8
Fibrous	6.0 ± 1.6	6.3 ± 1.5	4.5 ± 2.0	4.3 ± 1.7
Rate of breakdown	9.5 ± 1.4	10.0 ± 1.7	8.2 ± 1.3	8.1 ± 1.4
Chewiness	5.2 ± 1.6	5.7 ± 1.8	$4.5^{a} \pm 1.3$	$4.0^{b} \pm 1.1$

These data suggest that undesirable differences in the cooked texture characteristics between WB and normal breast meat are minimized in a ground product and WB fillets may be used for meat products in the ground form without adverse effects on finished product performance and sensory quality.

Sanchez-Brambila et al., 2017, Poult Sci 96:3489

Development of on-line grading systems to detect wooden breasts

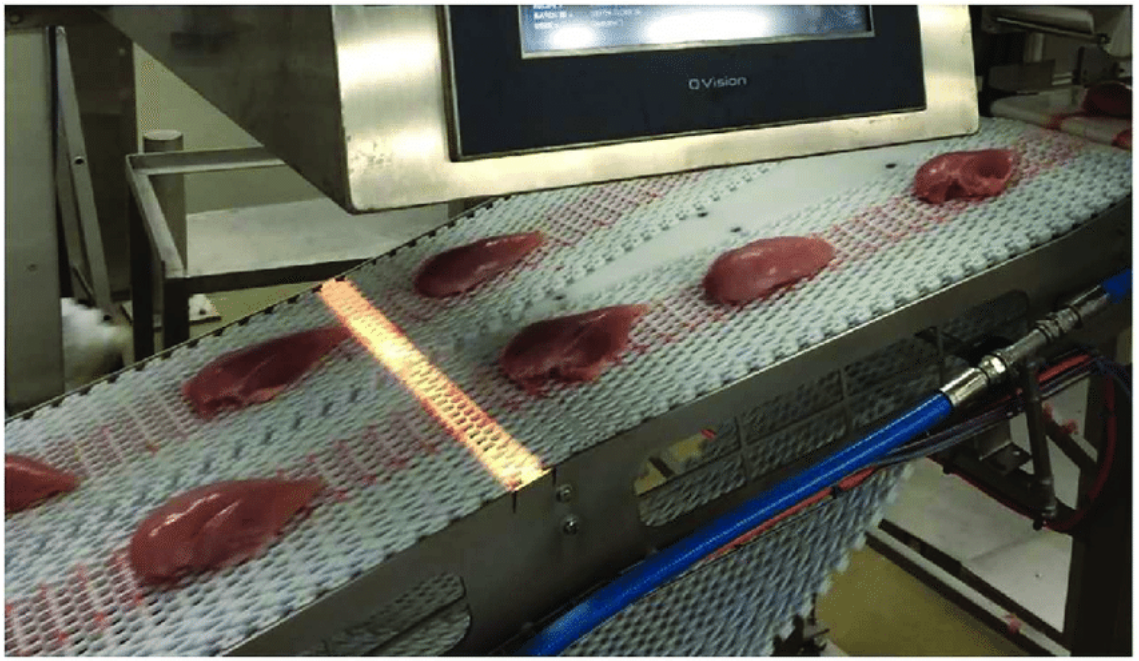
PLOS ONE

RESEARCH ARTICLE

PLoS ONE 12(3): e0173384
doi:10.1371/journal.pone.0173384
Published: March 9, 2017

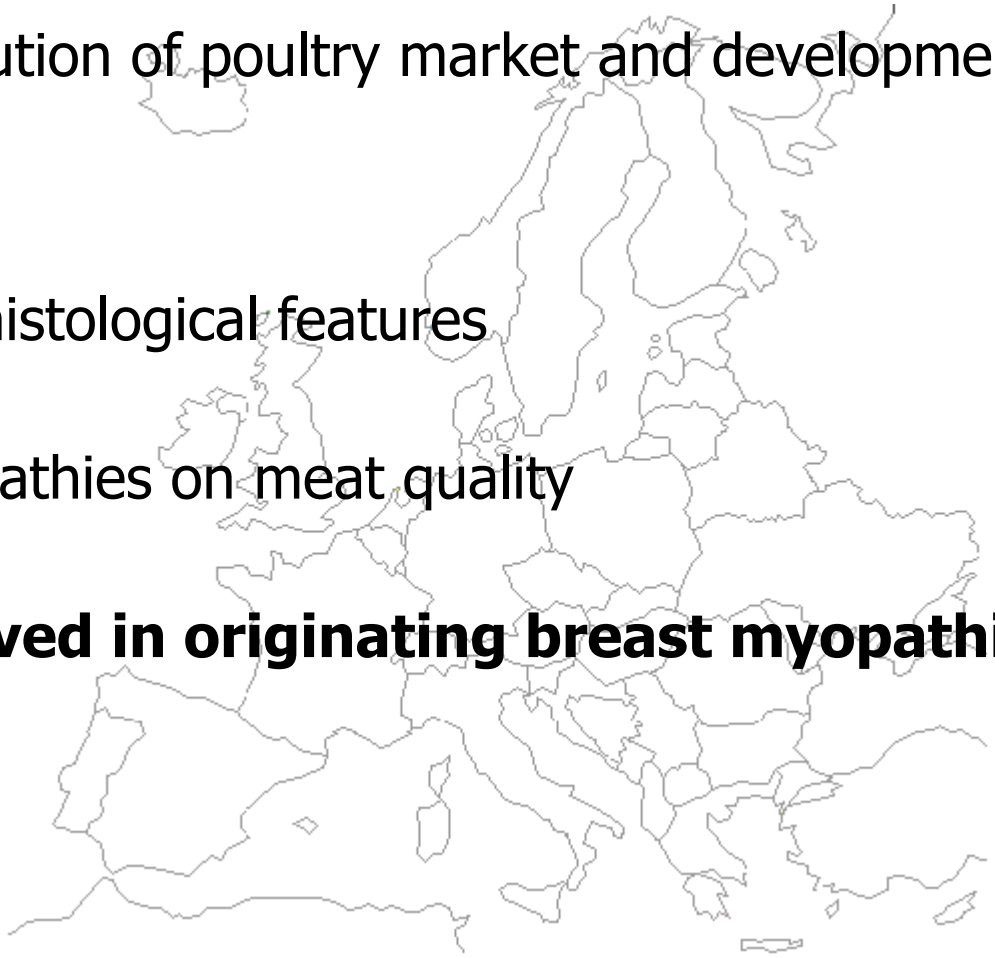
Rapid on-line detection and grading of wooden breast myopathy in chicken fillets by near-infrared spectroscopy

Jens Petter Wold[1]*, Eva Veiseth-Kent[1], Vibeke Høst[1], Atle Løvland[2]
1 Nofima AS, Norwegian Institute for Food and Fisheries Research, Muninbakken 9–13, Breivika, Tromsø, Norway, **2** Nortura SA, Lørenveien 37, Oslo, Norway



Outline of presentation

1. Relationship between evolution of poultry market and development of breast meat myopathies
2. Breast myopathies and its histological features
3. Implications of breast myopathies on meat quality
4. **Production factors involved in originating breast myopathies**
5. Conclusions



Production factors: Genetics

Trait	high-yielding chicken line Mean	SD	moderate-yielding chicken line Mean	SD
Body weight*kg (BW)	2.33	0.29	1.91	0.23
Processing body weight† (kg) (PW)	2.47	0.30	2.39	0.29
% Breast yield (BY)	29.4	2.09	21.66	1.49
% Wooden breast (WB)	3.19	0.54	0.16	0.01
% White striping (WS)	49.6	8.68	14.46	3.08

Moderate and low genetic correlations for WS (h^2=0.338) and WB (h^2=0.185)

Production factors: Genetics

Parameter	Estimated genetic correlation with WS[1]
Body weight	**0.33 ± 0.15**
Breast meat yield	**0.68 ± 0.06**
P. major yield	**0.73 ± 0.07**
P. minor yield	**0.48 ± 0.16**
Abdominal fat %	−0.12 ± 0.10
Leg percentage	0.02 ± 0.12

[1]Estimates in bold are significantly different from 0 based on their confidence intervals

(n=1,349; 6 wks of age; 2.8 kg)

Production factors: Genotype and slaughter age

Factor	Occurrence	References
Genotype	Ross 708 > Ross 308 Cobb 700 > Cobb 500	Petracci et al. (2013) Lorenzi et al. (2014)
Gender and BW at slaughter	- WS can appear also in light birds - WB occurs especially after 40 d with higher levels in males - SM especially occurs after 40 d with higher levels in females	Lorenzi et al. (2014) Kindlein et al. (2015) Ferreira et al. (2016) Kuttapan et al. (2017)

Production factors: Incubation

Incubation temperature and time of hatch impact broiler muscle growth and morphology

D. L. Clark,*,[1] K. G. Walter,† and S. G. Velleman*

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†Aviagen, Inc., Product Development Center, Albertville, AL 35951

2017 Poultry Science 0:1–11
http://dx.doi.org/10.3382/ps/pex202

- Increasing incubation temperature (39.5°C for 12 hours each day between d 14 and 18) reduced severity of microscopic features that are present in breast myopathies, however also body (4264 vs. 4378 g; P<0.01) and *P. major* weights (1289 vs. 1339 g; P<0.01) are reduced.
- Early hatch chicks had more severe microscopic myopathy score than either the mid and late hatch broilers.

Production factors: feeding

Occurrence of white striping and wooden breast in broilers fed grower and finisher diets with increasing lysine levels

R. F. A. Cruz,* S. L. Vieira,*,1 L. Kindlein,† M. Kipper,* H. S. Cemin,* and S. M. Rauber*

*Departamento de Zootecnia, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 7712, Porto Alegre, RS, 91540-000, Brazil; and †Departamento de Medicina Veterinária Preventiva, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 8834, Porto Alegre, RS, 91540-000, Brazil

2017 Poultry Science 96:501–510
http://dx.doi.org/10.3382/ps/pew310

Effect of different levels of dietary zinc, manganese, and copper from organic or inorganic sources on performance, bacterial chondronecrosis, intramuscular collagen characteristics, and occurrence of meat quality defects of broiler chickens

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*Department of Agricultural and Food Sciences, Alma Mater Studiorum – University of Bologna, Italy; †Department of Agricultural, Environment and Food, University of Molise, Italy; and ‡Novus International Inc., 20 Research Park Drive, St. Charles, MO

2016 Poultry Science 95:1813–1824
http://dx.doi.org/10.3382/ps/pew064

Effect of genotype, gender and feed restriction on growth, meat quality and the occurrence of white striping and wooden breast in broiler chickens

A. Trocino,*,1 A. Piccirillo,* M. Birolo,† G. Radaelli,* D. Bertotto,* E. Filiou,† M. Petracci,‡ and G. Xiccato†

*Department of Comparative Biomedicine and Food Science (BCA), University of Padova, Viale dell'Università 16, I-35020 Legnaro, Padova, Italy; †Department of Agronomy Food Natural Resources Animal and Environment (DAFNAE), University of Padova, Viale dell'Università 16, I-35020 Legnaro, Padova, Italy; and ‡Department of Agricultural and Food Sciences, Alma Mater Studiorum, University of Bologna, I-47521Cesena, Forlì Cesena, Italy

2015 Poultry Science 94:2996–3004
http://dx.doi.org/10.3382/ps/pev296

Wooden Breast Myodegeneration of Pectoralis Major Muscle Over the Growth Period in Broilers

Veterinary Pathology
2017, Vol. 54(1) 119-128
DOI: 10.1177/0300985816658099
journals.sagepub.com/home/vet

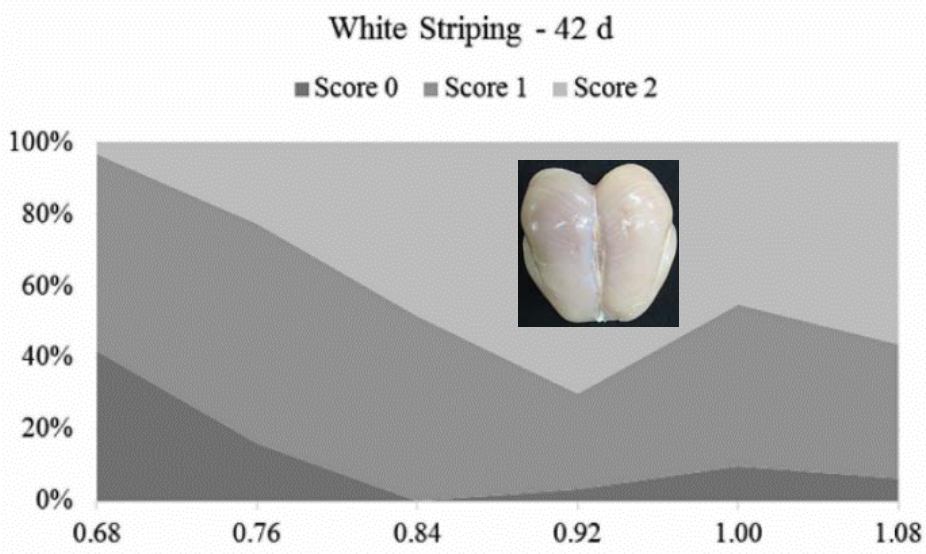
H.-K. Sihvo[1,2], J. Lindén[2], N. Airas[2], K. Immonen[1], J. Valaja[3], and E. Puolanne[1]

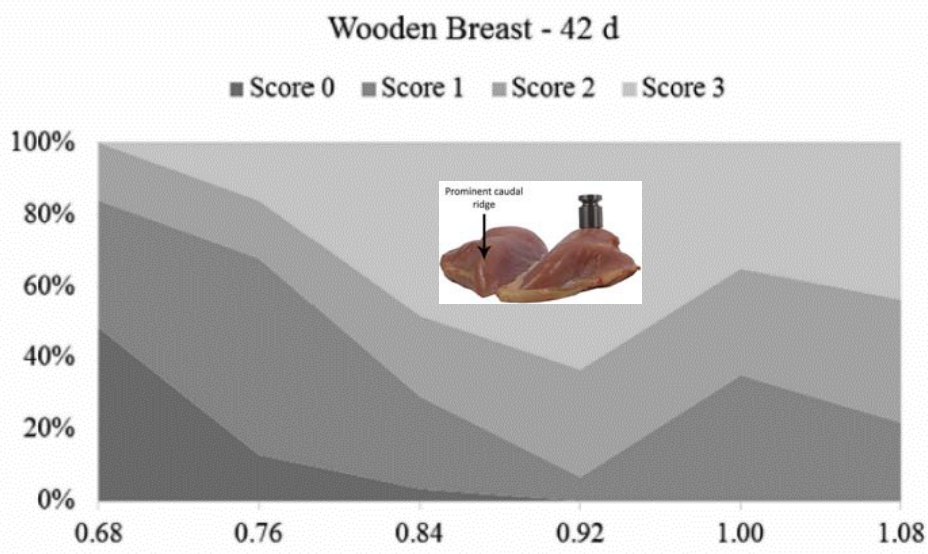
Production factors: feeding

Two experiments were conducted to evaluate the prevalence and severity of white striping (WS) and wooden breast (WB) in breast fillets from broilers fed diets with increasing digestible Lysine (dLys) from 12 to 28 d (**Exp. 1, 0.77 to 1.17%**) and from 28 to 42 d (**Exp. 2, 0.68 to 1.07%**).

dLys, %[2]		Body weight, g		Carcass weight[3], g		Breast fillets[4]	
Exp. 1 (12 to 28 d)	Exp. 2 (28 to 42 d)	35 d	42 d	35 d	42 d	35 d	42 d
0.77	0.68	2,159^{d}	3,084^{c}	1,656^{d}	2,424^{c}	21.3^{c}	21.7^{d}
0.85	0.76	2,282^{c}	3,285^{b}	1,778^{c}	2,592^{b}	22.8^{b,c}	23.0^{c}
0.93	0.84	2,323^{b,c}	3,452^{a}	1,813^{b,c}	2,764^{a}	23.7^{a,b}	24.5^{b}
1.01	0.92	2,415^{a}	3,517^{a}	1,896^{a}	2,837^{a}	24.4^{a}	25.7^{a}
1.09	1.00	2,389^{a,b}	3,468^{a}	1,873^{a,b}	2,793^{a}	24.2^{a}	25.0^{a,b}
1.17	1.08	2,393^{a,b}	3,513^{a}	1,866^{a,b}	2,804^{a}	24.1^{a}	24.9^{a,b}
SEM		14.9	27.0	13.3	24.4	0.21	0.23
P-value		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Production factors: feeding





Conclusions: Since BW and growth rate are results of increasing dLys levels, myopathies do not seem to be associated with lysine itself but gains in performances.

Production factors: feeding

Item	Sources (S)		Dose (D)	
	OTM[1]	ITM[1]	HI[2]	LO[2]
n.	400	400	400	400
White striping				
Score 0 (no lesions) (%)	39.6	39.3	38.8	40.0
Score 1 (mild lesions) (%)	22.6	21.6	22.8	21.5
Score 2 (severe lesions) (%)	37.8	39.0	38.3	38.5
Chi-square	0.134		0.223	
Wooden breast				
Score 0 (no lesions) (%)	88.8	84.3	87.0	86.0
Score 1 (mild lesions) (%)	0.80	1.50	1.30	1.00
Score 2 (severe lesions) (%)	10.5	14.3	11.8	13.0
Chi-square	3.741		0.387	
Poor cohesion				
Score 0 (no lesions) (%)	53.1	64.5	57.4	60.3
Score 1 (mild lesions) (%)	37.6	31.5	36.3	32.8
Score 2 (severe lesions) (%)	9.30	4.00	6.30	7.00
Chi-square	14.909***		1.185	

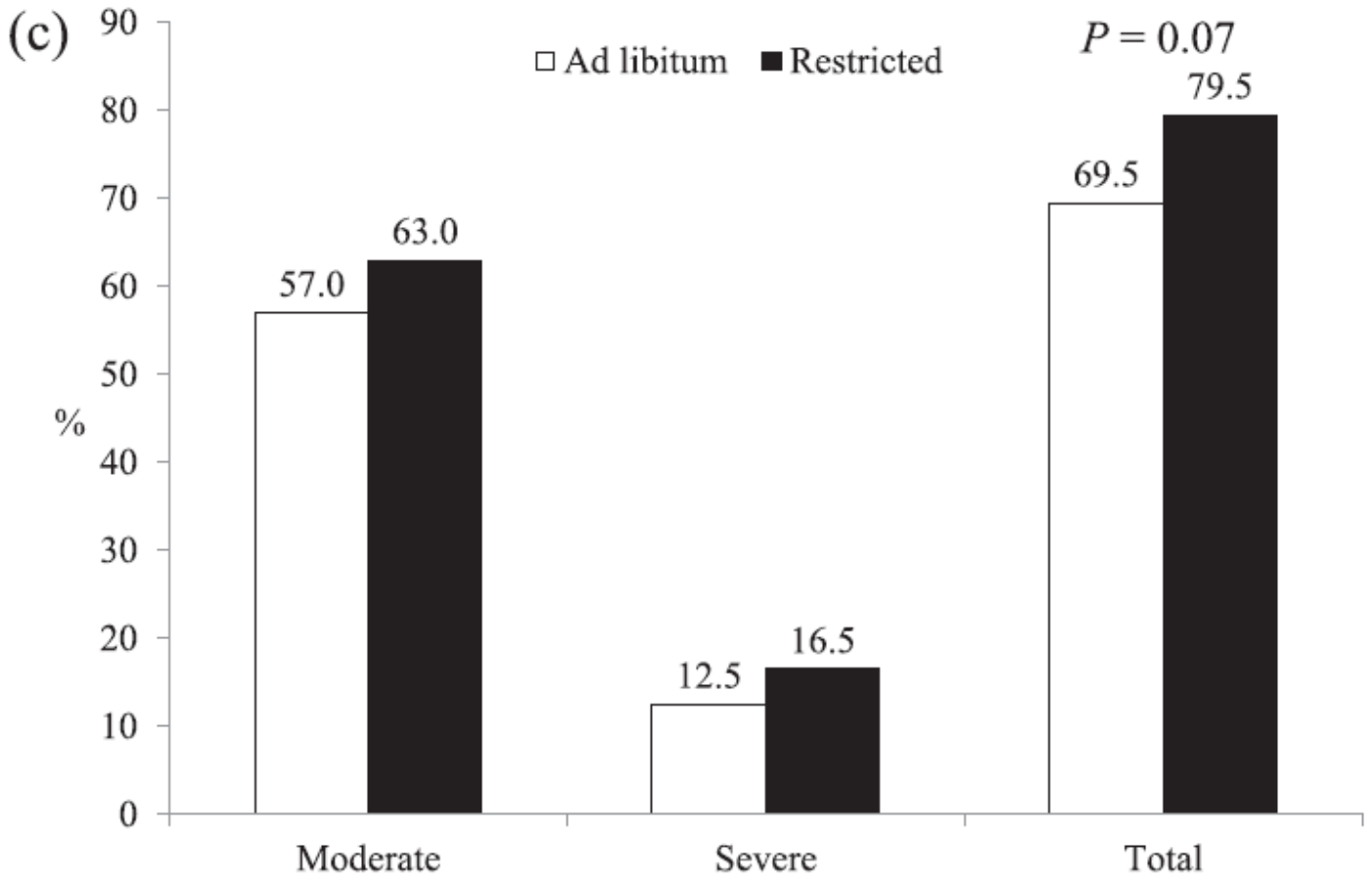
[1]OTM = organic trace mineral; ITM = inorganic trace mineral.
[2]HI = high dose; LO = low dose.
***: $P < 0.001$.

Production factors: feeding

Item	Feeding system (F)		F
	Ad libitum	Restricted	
Broilers (n)	362	366	
Live weight (g)			
On d 1	51	51	0.57
On d 22	1,023	878	<0.001
On d 46	3,194	3,142	<0.01
First period (1 to 22 d)			
Weight gain (g/d)	46.3	39.4	<0.001
Feed intake (g/d)	61.5	52.5	<0.001
Second period (23 to 46 d)			
Weight gain (g/d)	91.5	95.4	<0.001
Feed intake (g/d)	166	168	0.14
Whole trial (1 to 46 d)			
Weight gain (g/d)	70.7	69.5	<0.01
Feed intake (g/d)	113	109	<0.001

Feeding system:
ad libitum vs. early restriction
(80% from 13 to 21 d of age)

Production factors: feeding



Trocino *et al.*, 2015, Poult Sci 95:2996

Production factors: feeding

Wooden Breast Myodegeneration of Pectoralis Major Muscle Over the Growth Period in Broilers

Veterinary Pathology
2017, Vol. 54(1) 119-128
DOI: 10.1177/0300985816658099
journals.sagepub.com/home/vet

H.-K. Sihvo[1,2], J. Lindén[2], N. Airas[2], K. Immonen[1], J. Valaja[3], and E. Puolanne[1]

The birds were assigned for 2 *ad libitum* dietary treatments:
SeLow (inorganic selenium - 0.11 mg/kg for 1st wk, and 0.13 mg/kg until 6th wk)
SeNorm (organic selenium yeast - 0.32 mg/kg for 1st wk, and 0.30 mg/kg until 6th wk)

Restriction of dietary selenium did not affect the occurrence of WB in the current study.

Outline of presentation

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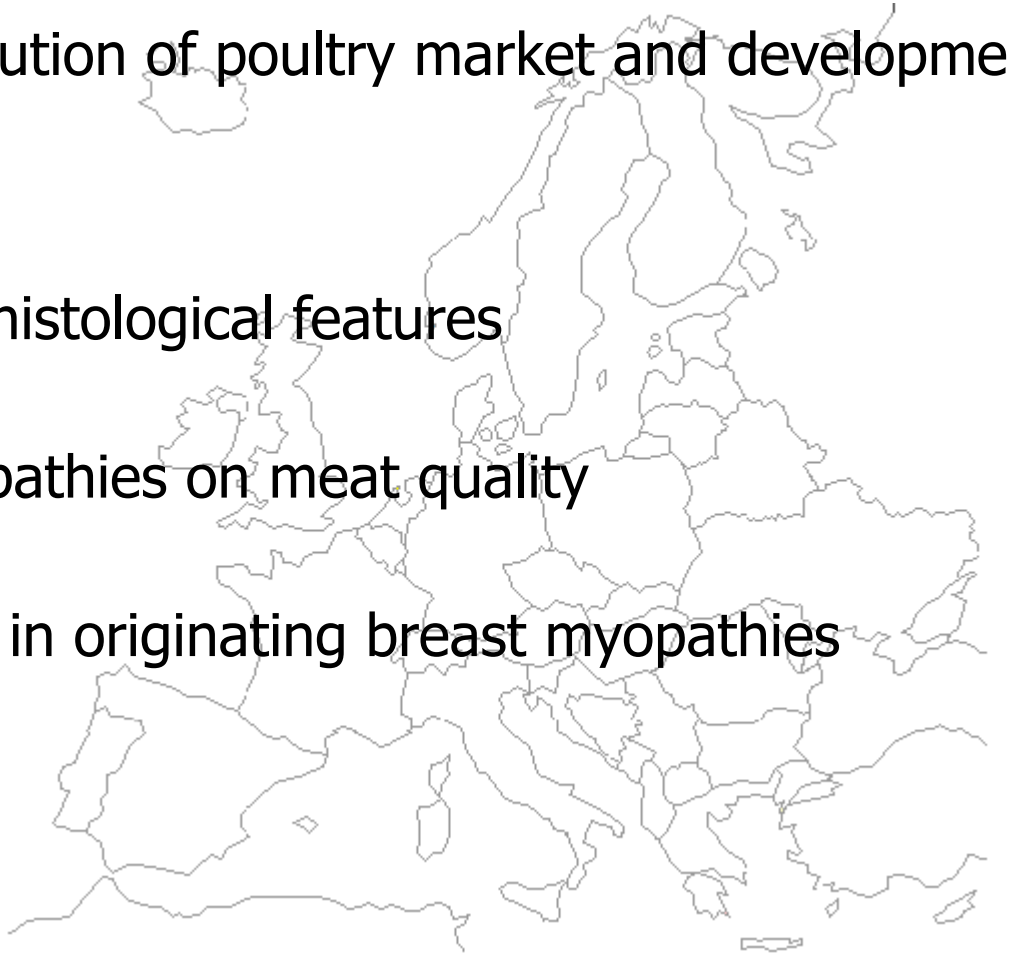


Conclusive remarks (1)

Occurrence of breast myopathies is a major concern for broiler industry in many Countries due to high economical losses:

- Condemnation/trimming (whole breast, carcass)

March 30, 2016

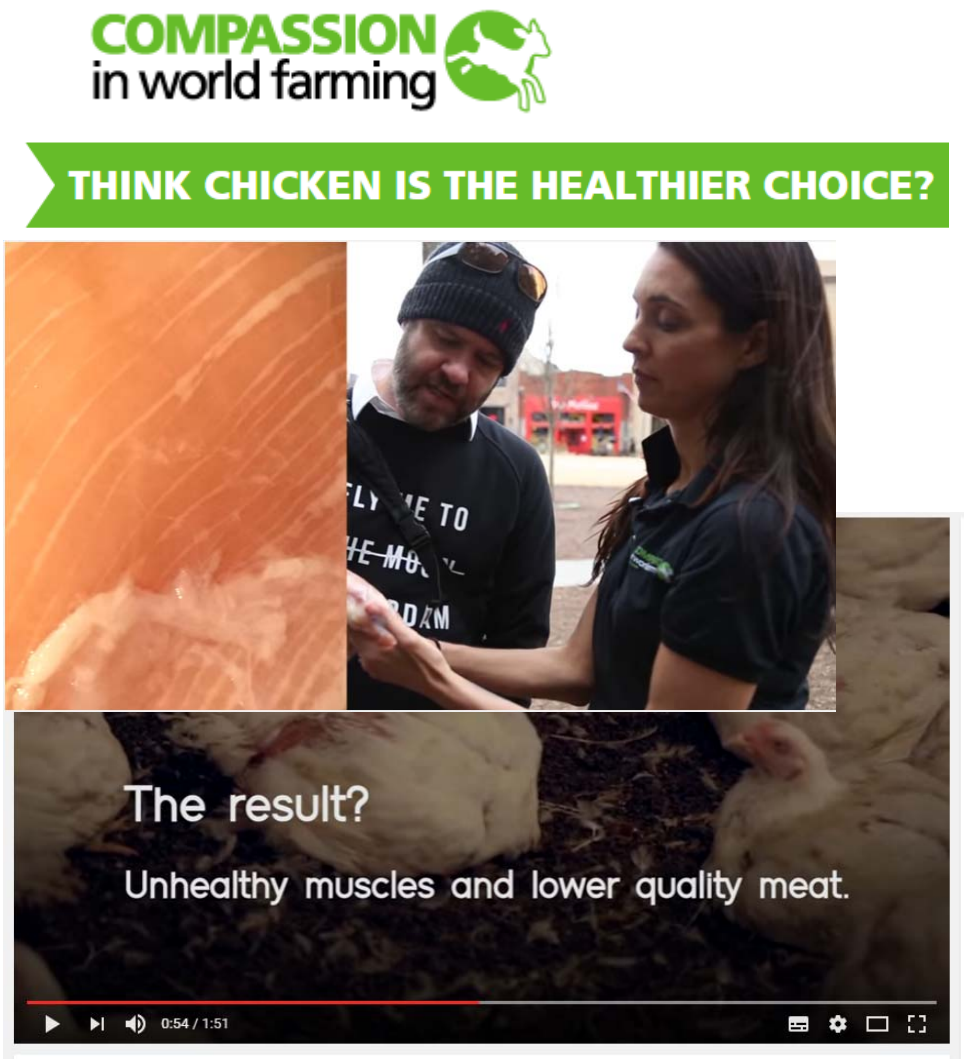
- Decreased yield and value (due to lower WHC)

- Increased need of manual sorting at deboning line (adding and training of personnels for grading/sorting)

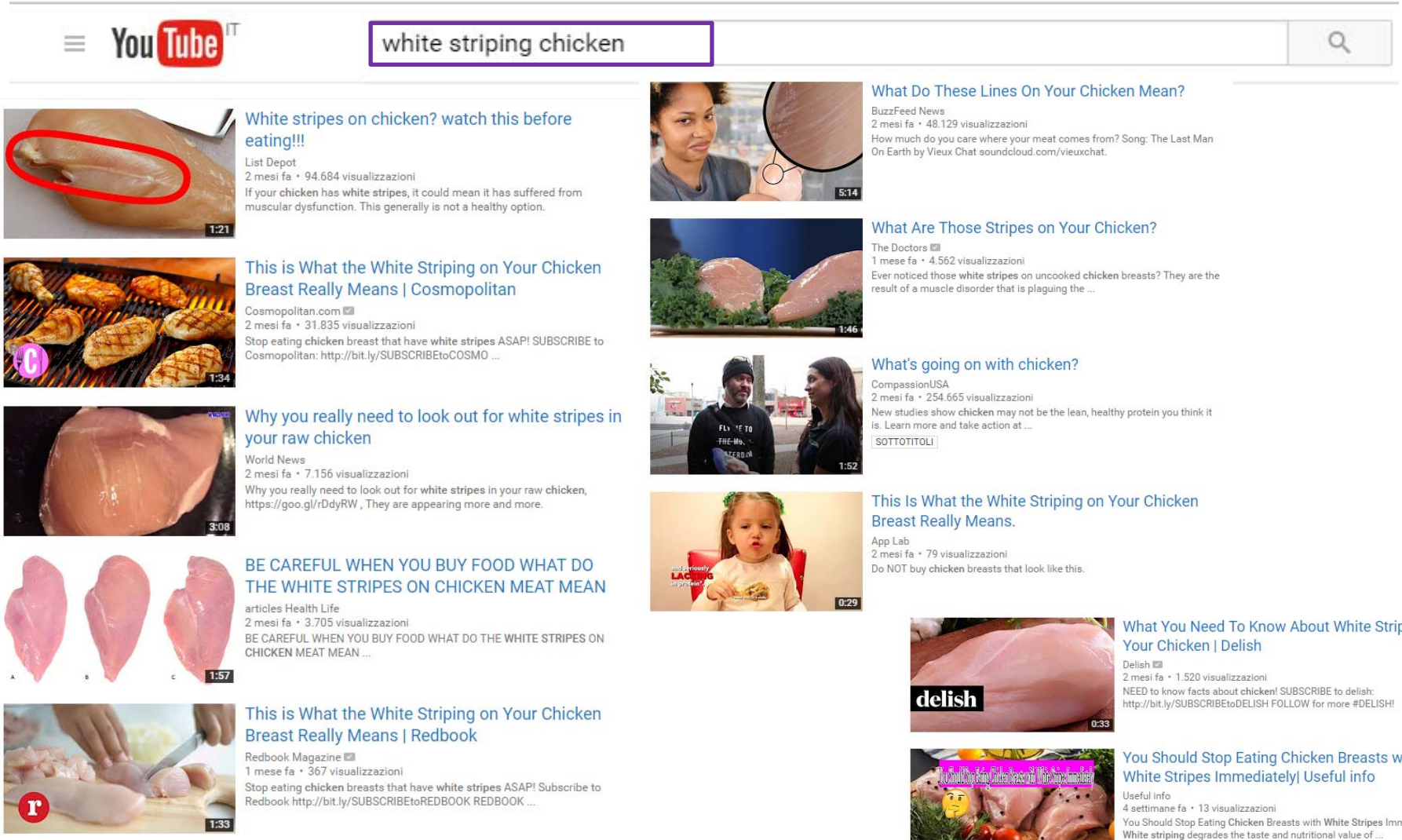
Conclusive remarks (2)

- Lost business due to perceptions

A leading farm animal welfare organization on last February launched a campaign in the US to make consumers aware that white striations on breast meat surface are associated with declined nutritional value of "factory" farmed chicken.



Conclusive remarks (3)



Conclusive remarks (4)

• It seems that poultry industry as whole (not only genetic companies) cannot longer postpone a closer view of problems related to the proper muscle growth and then of the quality of resulting meat when selecting and choosing genotypes for broiler production.

Acknowledgements

- Claudio Cavani
- Adele Meluzzi
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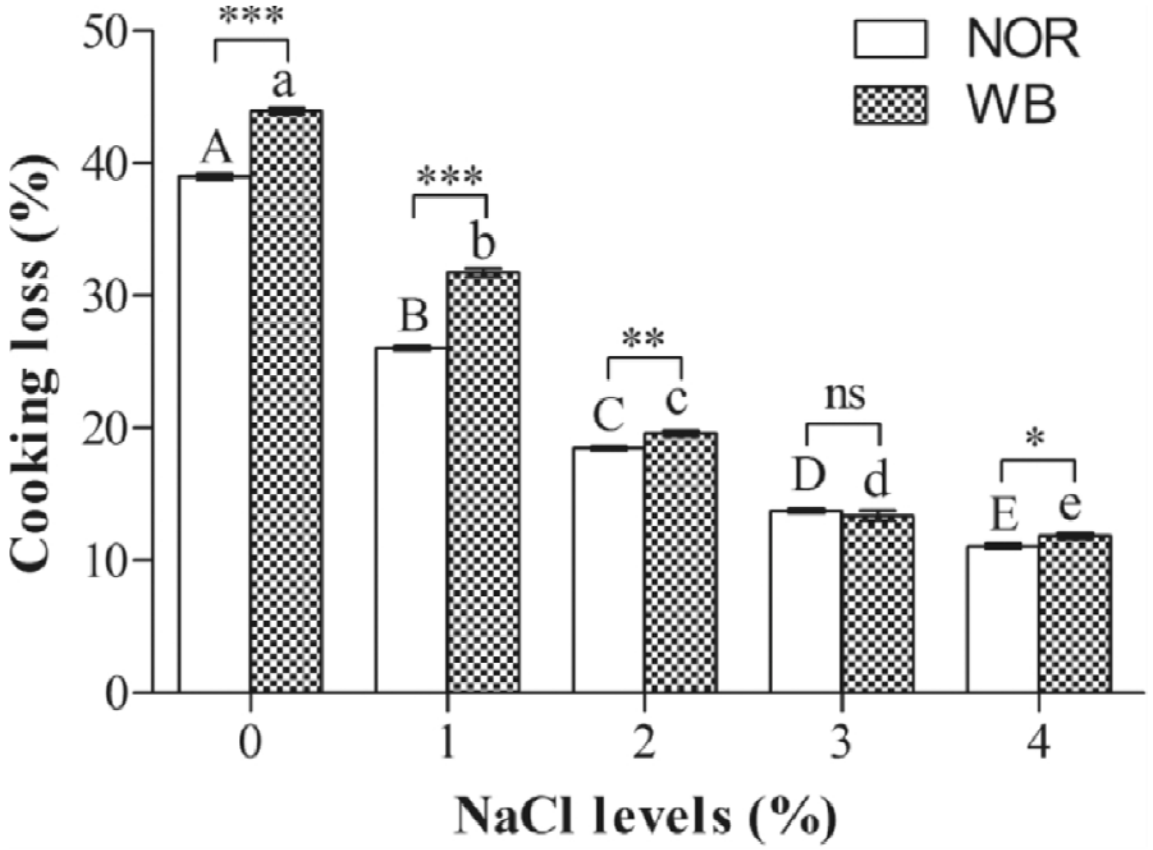
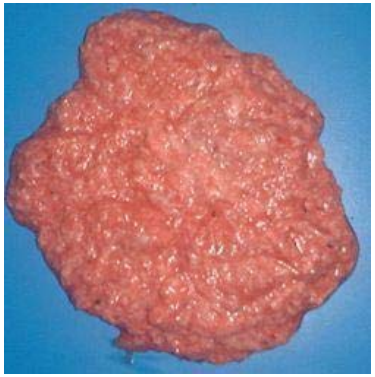
- Francesca Soglia
- Giulia Baldi
- Luca Canonico
- Martina Zappaterra
- Marco Lorenzi
- Marco Della Pasqua
- Angelo Bonfiglio

Implications on technological properties of the meat

Cooking loss of WB and NOR chicken breast meat batters with various NaCl contents

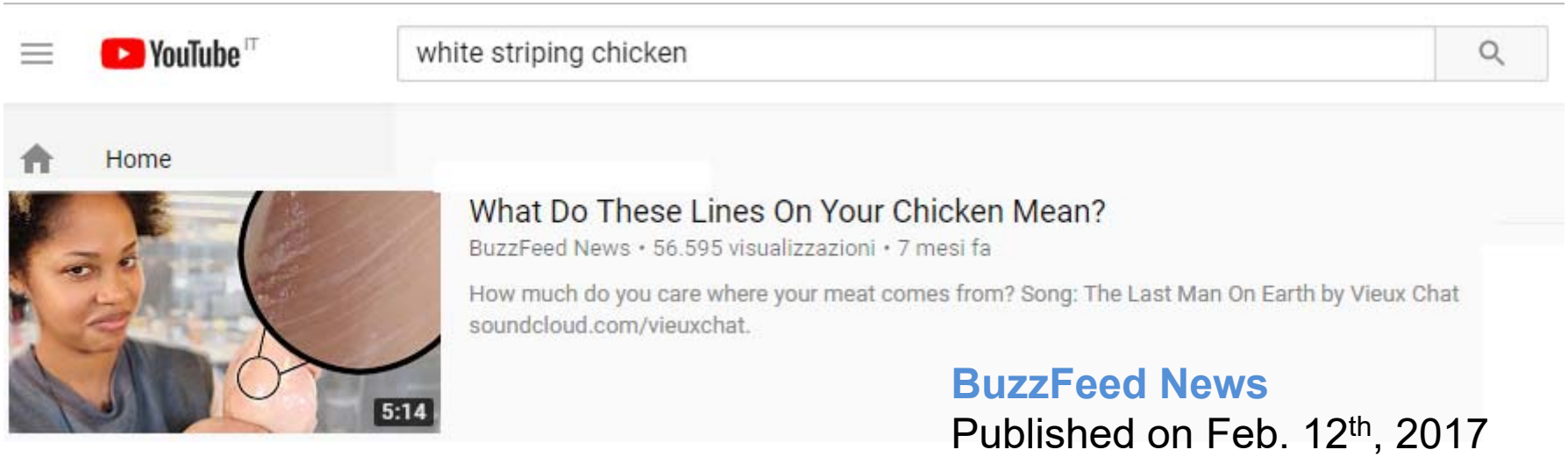




Xing et al. (2017 Poult Sci 96:3473*)*

Conclusive remarks (2)

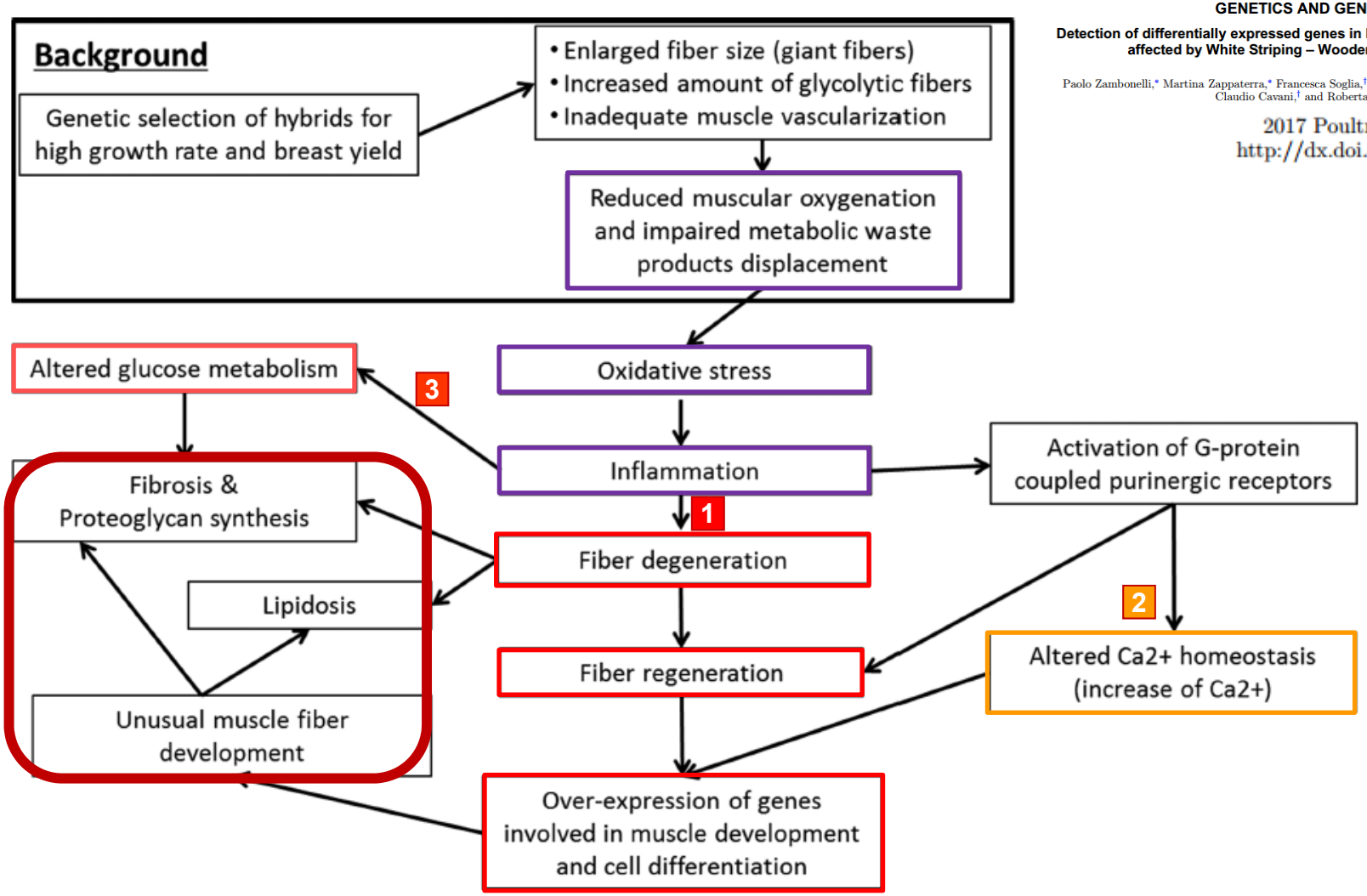
- Lost business due to perceptions



BuzzFeed News
Published on Feb. 12th, 2017

Independent (UK)
Published on Feb. 6th, 2017

Mechanisms involved in breast myopathy development



GENETICS AND GENOMICS

Detection of differentially expressed genes in broiler pectoralis major muscle affected by White Striping – Wooden Breast myopathies

Paolo Zambonelli,* Martina Zappaterra,* Francesca Soglia,† Massimiliano Petracci,† Federico Sirri,† Claudio Cavani,† and Roberta Davoli*,1

2017 Poultry Science 95:2771–2785
http://dx.doi.org/10.3382/ps/pew268