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Monopoli (Bari, Italy), June 13-16, 2023

ASSESSMENT OF MUSCLE METABOLISM IN A DIFFERENTLY KINETIC CHICKEN GENOTYPE USING THE *ACTIVITY INDEX*

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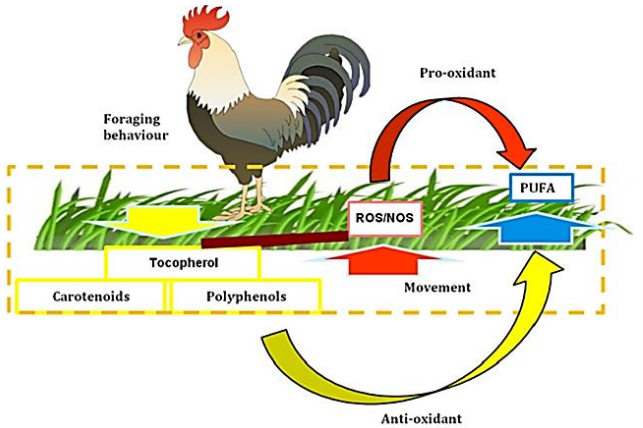
Growing consumer interest in poultry meat from extensive and organic rearing system

-more welfare and health needs of animals
-more healthy products

Pastured birds increasing meat quality due to the intake of bioactive compounds

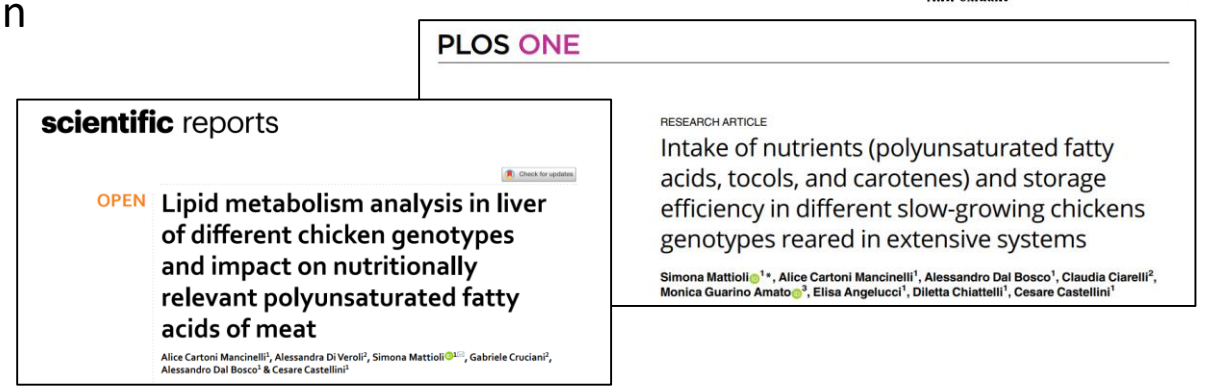


Not all the genotype can achieve the same benefits and adaptability

Fast-growing (FG) chickens are not suitable for alternative broiler production (i.e., free-range and organic)

VS

Slow growing (SG) chickens can fully benefit of the outdoor run



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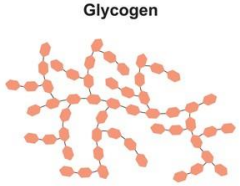
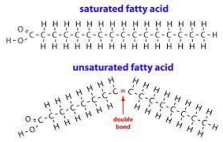
The locomotor muscles obtain energy for the kinetic activity mainly from

→ carbohydrate



→ fatty acids



Chicken locomotory muscles are located in the **thigh** and they are **richer in fat** compared to breast muscles

Leg muscles are capable **to mobilize** a great quantity of **fatty acids** to produce **energy for movement**.

Muscle contraction, velocity and range of motion **depend on fiber types**
energy metabolism changes accordingly

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WHITE MUSCLE

RED MUSCLE

Glycolytic fibers (type IIb or White)

- lower contents of mitochondria and myoglobin
- fast and short contracting activity

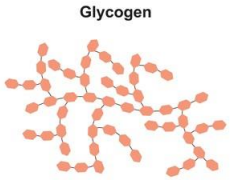
Use **glycogen** as energy source

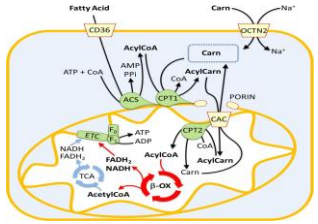
Oxidative fibers (type I or Red)

- large presence of mitochondria and high myoglobin
- slow movements for long periods

Produce energy from **fatty acid** β-oxidation

This is an aerobic breaking down of fatty acids particularly evident in High Unsaturated Fatty Acids (HUFA)





kinetic activity causes

lower **higher**

consume of HUFA

the rate of n-3 b-oxidation in the muscle (n-3 HUFA/ALA) can **describe n-3 HUFA mobilization** used for movement and the oxidative status

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An index to measure the activity attitude of broilers in extensive system

Sebastiana Failla *, Luca Buttazzoni *, David Meo Zilio *, Michela Contò *, Gianluca Renzi *, Cesare Castellini †, Monica Guarino Amato *

$$\textit{Activity index} = \textit{White m}\ \frac{(n\text{-}3\ HUFA)}{ALA} - \textit{Red m}\ \frac{(n\text{-}3\ HUFA)}{ALA}$$

Activity index based on β-oxidation differences between red and white thigh muscles of the same chicken to estimate their kinetic activity

MATERIALS AND METHODS

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One hundred chicks of Nacked Neck genotype were reared

- **outdoor (O)** (housing in an indoor pen, 0.10 m^2/bird with access to a grassed paddock, 4 m^2/bird)
- **indoor (I)** (housing in indoor pen, 0.10 m^2/bird)

The trial was carried out at the experimental farm of the University of Perugia (Italy)

The animals were fed *ad libitum* the same diet (starter 1-21 d, grower 22 until slaughter 81 d)

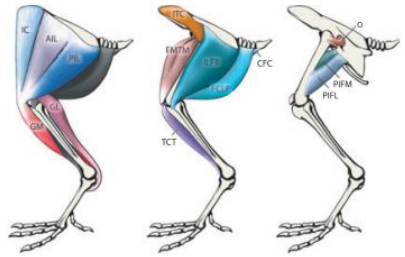
A kinetic monitoring system, constituted by chips and antennas for recording the times that chicken pass through the area (LUNA GERB, Italy), outlined **two Outdoor groups**

- **high (OH)** kinetic activity
- **low (OL)** kinetic activity

At 81 days of age, 30 chickens were selected and slaughtered (n=10/groups)

The left thigh was excised and dissected from each carcass/group

Thigh muscles great differences in terms of fiber, color and fatty acid composition



Journal of Anatomy

J. Anat. (2010) 217, pp153–166 doi: 10.1111/j.1469-7580.2010.01251.x

The effects of selective breeding on the architectural properties of the pelvic limb in broiler chickens: a comparative study across modern and ancestral populations

Heather Paxton,[1] Nicolas B. Anthony,[2] Sandra A. Corr[3] and John R. Hutchinson[1]

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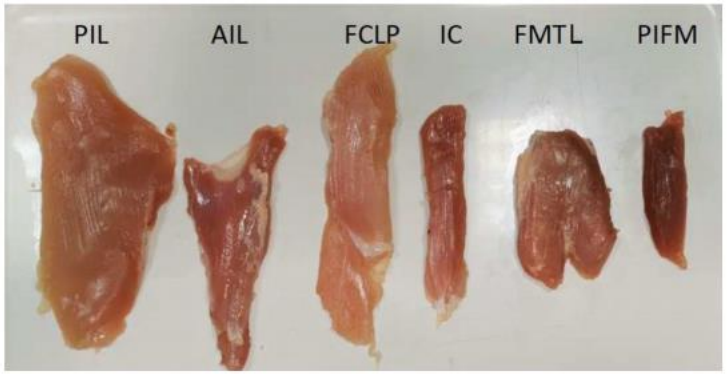
[2]Poultry Science Center, University of Arkansas, Fayetteville, AR, USA
[3]Division of Surgery, School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington, Leicestershire, UK



M iliotibialis lateralis postacetabularis (PIL); M. iliotibialis lateralis preacetabularis (AIL); M. flexor cruris lateralis pars pelvica (FCLP); M. iliotibialis cranialis (IC); M. femorotibialis lateralis (FMTL); M. puboischiofemoralis pars medialis (PIFM).

M. iliotibialis lateralis postacetabularis (PIL, glycolytic) and *M. puboischiofemoralis pars medialis* (PIFM, oxidative) muscles were removed and stored at -20 °C for fatty acid evaluation by GC-FID

RESULTS

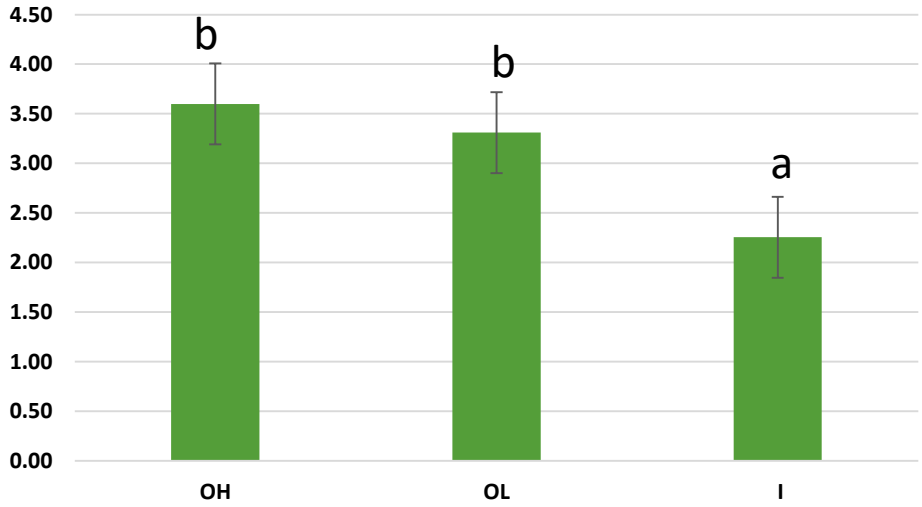
Fatty acids%, of total FA	OH		OL		I			
	PIL	PIFM	PIL	PIFM	PIL	PIFM	RMSE	p value
C18:3 n-3, α-ALA	0,60	0,83	0,61	0,74	0,78	0,83	0,15	**0,002**
C20:5n-3, EPA	1,60	0,95	1,48	0,76	1,16	1,04	0,26	**0,000**
C22:5n-3, DPA	0,80	0,40	0,61	0,23	0,53	0,39	0,20	**0,000**
C22:6n-3, DHA	1,63	1,24	1,71	0,69	1,58	2,01	0,38	0,096
n3 HUFA/ALA	6,77	3,18	5,13	2,27	4,38	4,25	0,67	**0,004**
n-3 HUFA	4,02	2,59	3,80	1,68	3,27	3,45	1,21	**0,030**
∑PUFA	29,65	28,38	27,73	24,65	28,44	28,65	0,73	0,118

∑PUFA = ∑n-6+ ∑n-3; n-3 HUFA=∑ (C20:5n-3, C22:5 n-3, C22:6 n-3); ALA = C18:3 n-3
PIL (M. iliotibialis lateralis postacetabularis) thigh white muscle
PIFM (M. puboischiofemoralis pars medialis) thigh red muscle

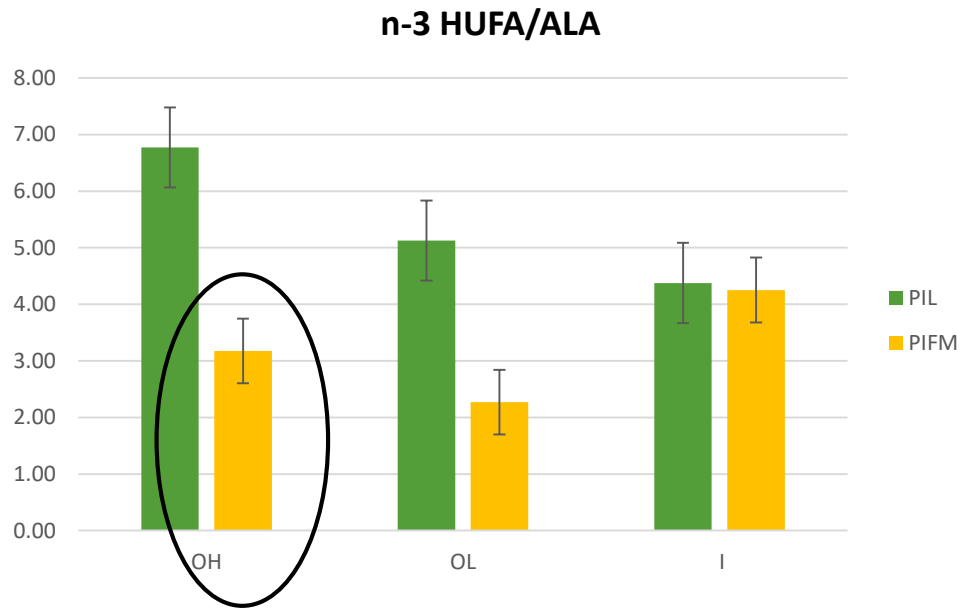
	OH	OL	I
activity index	3,60	3,31	2,25

Activity index = n-3 HUFA/ALA (PIL) − n-3 HUFA/ALA (PIFM).

ACTIVITY INDEX



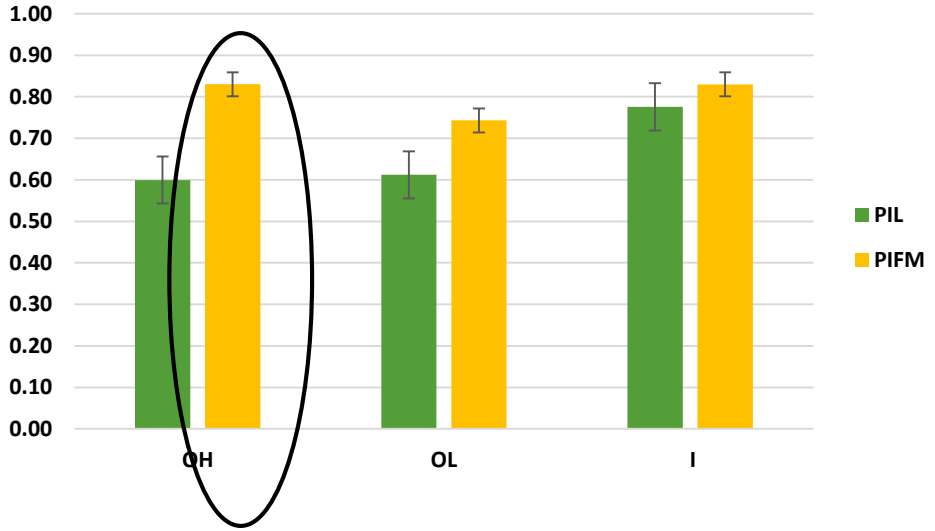
a,b= p<0,05



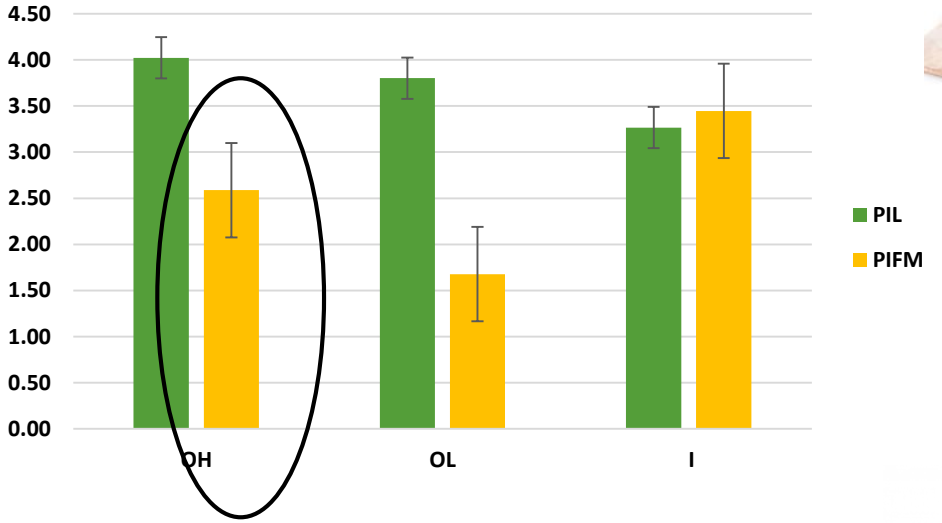
Red muscle metabolism produces energy mainly by β-oxidation of Highly Unsaturated n-3 Fatty Acids (HUFA).

the ratio between n-3 HUFA and their precursor C18:3 n-3 (ALA) is likely to be **lower in red** than in white muscles

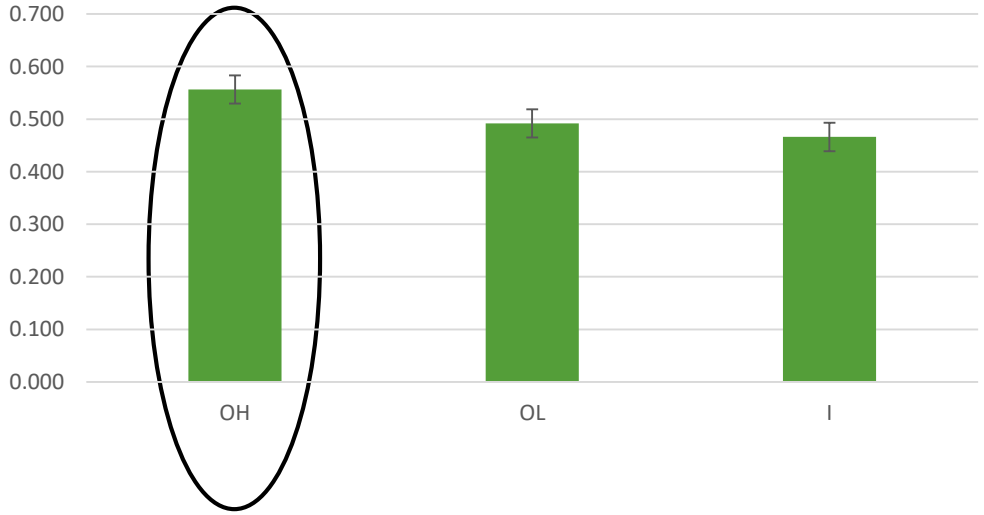
C18:3 n-3, α-ALA THIGH



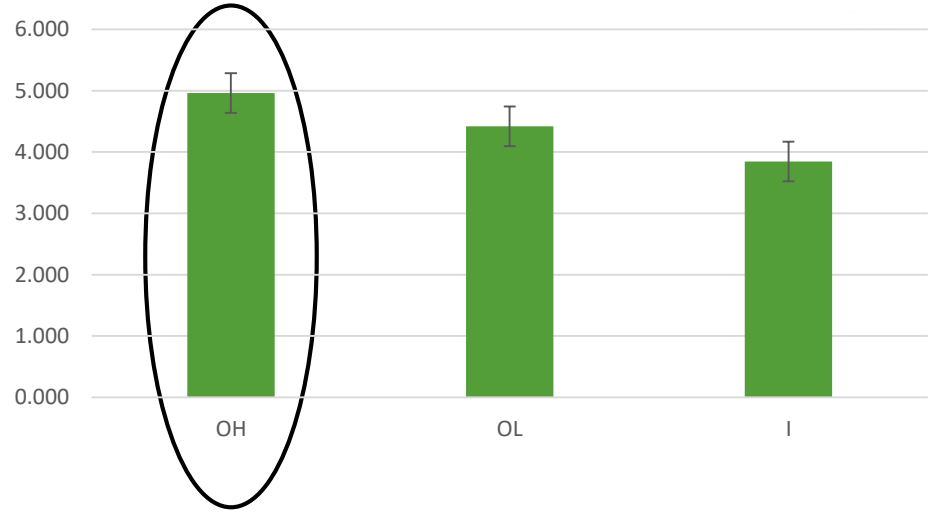
n-3 HUFA THIGH

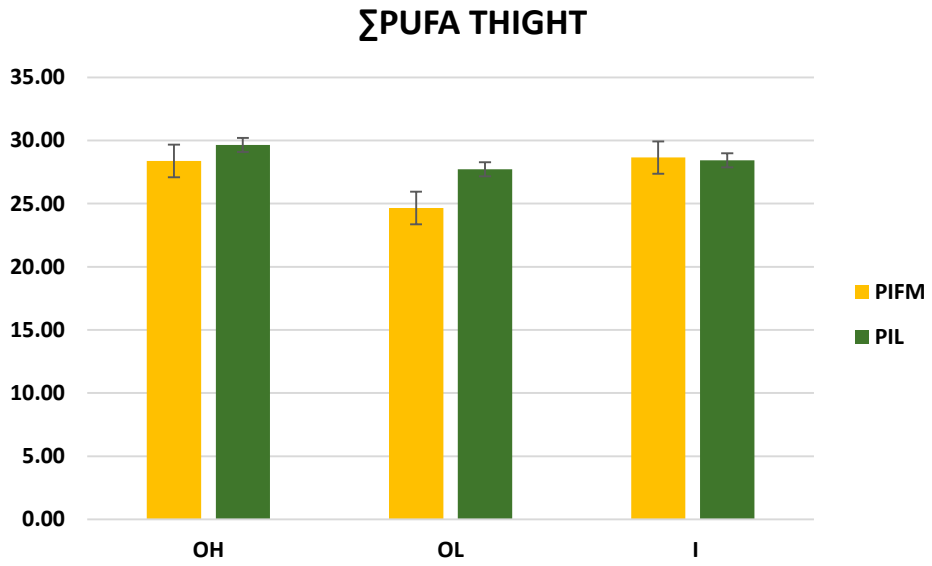


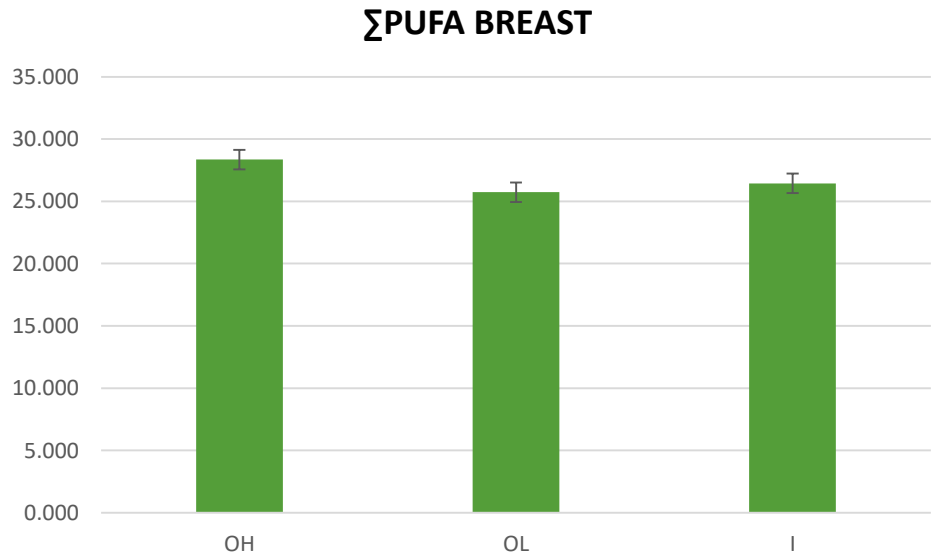
C18:3 n-3,α-ALA BREAST



N-3 HUFA BREAST




∑PUFA THIGHT
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
OH
OL
I
PIFM
PIL


∑PUFA BREAST
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
OH
OL
I

CONCLUSION

- The activity index could be a post-mortem marker of the kinetic activity of a given genotype and also the assessment of adaptability to alternative rearing systems
- The data show the activity index can give information on which experimental group used the outdoor spaces the more.
- The data showed that the OH group, while walking more, was also able to store more HUFA than OL group in the PIFM muscle due to a higher ingestion of the ALA precursor from grazing
- The activity index can be useful to understand and give insight into the metabolism of n-3HUFAs in different genotypes, and nutritional value of the meat product

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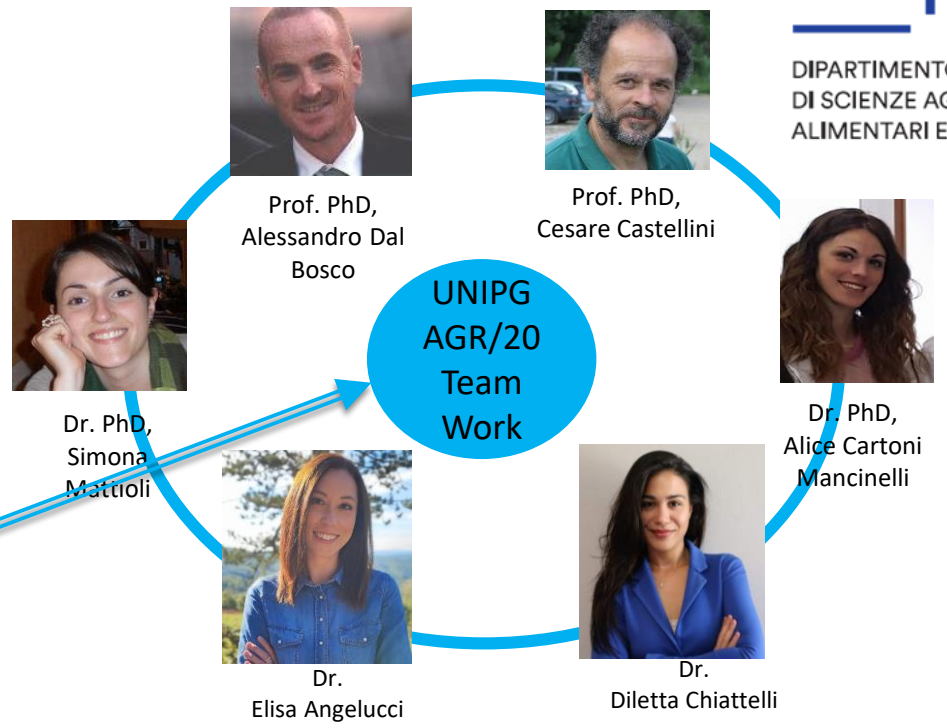

thanks for the attention

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