The Composition of Wagyu fat and its health benefits

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Wagyu beef quality and health implications

- The number of Wagyu breeders and popularity of its beef are growing
- Virtually no research has been done on local Wagyu beef.
- This paper presents data on the composition of Intramuscular (IM), subcutaneous fat (SCF) and perirenal fat (PRF) of Wagyu and conventional cattle
- The concern raised was that the higher amount of fat in Wagyu is unhealthy

Fats in red meat

- Fats = mainly [triacylglycerols] in muscle, adipose tissue and phospholipids in the membrane fractions (Webb et al., 1998; De Smet et al., 2000; Webb & Casey, 1995; Webb & O'Neill, 2008; Wood et al., 2008; Webb, 2021)
- Fats = essential as energy source and for fat-soluble vitamins (A,D,E,K)
- Essential fatty acids - required for the synthesis of steroid hormones + carotenoids
- Ruminants incorporate essential fatty acids into muscle rather than adipose tissue (Wood et al., 2008).

Meat Quality

Meat quality

Extrinsic factors

1. Species
2. Breed
3. Age (chronologica physiological)
4. Gender
5. Feeding (fattening

Intrinsic factors

1. Muscle structure and composition
2. Connective tissue structure & composition (background toughness)
3. Natural proteases (calpains and calpastatins)
4. Fat content & fatty acid composition
5. Meat & fat colour

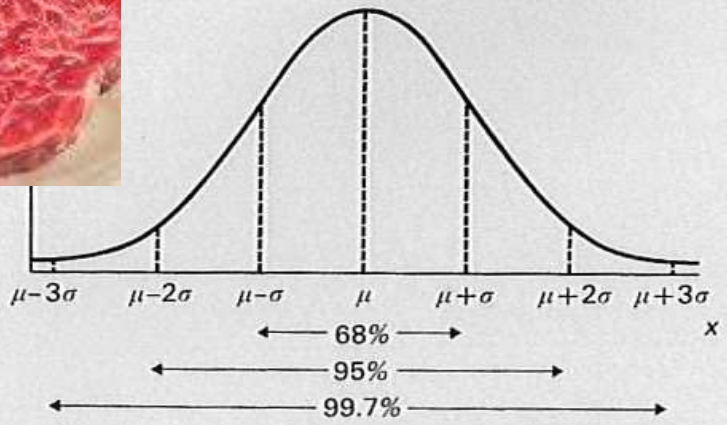
Conversion of muscle to meat

Meat processing, preparation,

sensory properties and

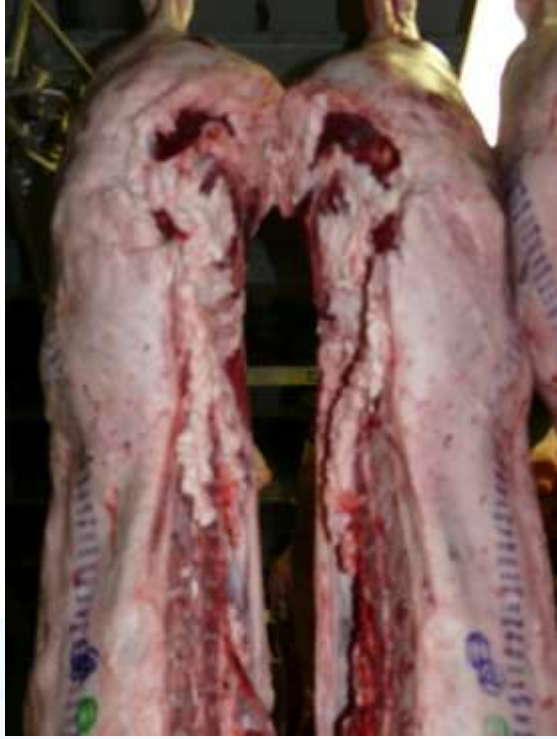
consumer perception

Variation in e.g. Meat Fat Content = G + E (Intensity + time of feeding)



Carcass fat content and quality influence meat quality

- Fat quality depends on:
  1. Amount and fatty acid composition
  2. SFA, UFA, MUFA, PUFA
  3. n-3, n-6, n-9 ratios (n-6/n-3 ratio < 5)
  4. Colour (variations from white to yellow)
  5. Risk of autoxidation (Rancidity)
  6. *Trans*-fatty acid content



Why the concerns about fats in red meats?

Numerous misconceptions exist about fats and fatty acids in red meats, e.g.

1. *"The consumption of excess red meat and alcohol, may adversely affect the life expectancy of humans"*
2. Resulted in a perception that red meat contains high-fat and saturated fatty acids
3. The "high fat" content of red meats is blamed as a risk factor for cardiovascular heart disease (CHD) & cardiovascular diseases (CVD) in humans.
4. The "unhealthy fatty acids" are associated with high cholesterol concentrations, CHD and the metabolic syndrome.
5. Recent concerns about *trans*-fatty acids in red meats?
6. Trans FA's are generally associated with CHD, CVD and they may be carcinogenic)

Gas chromatography of Wagyu beef

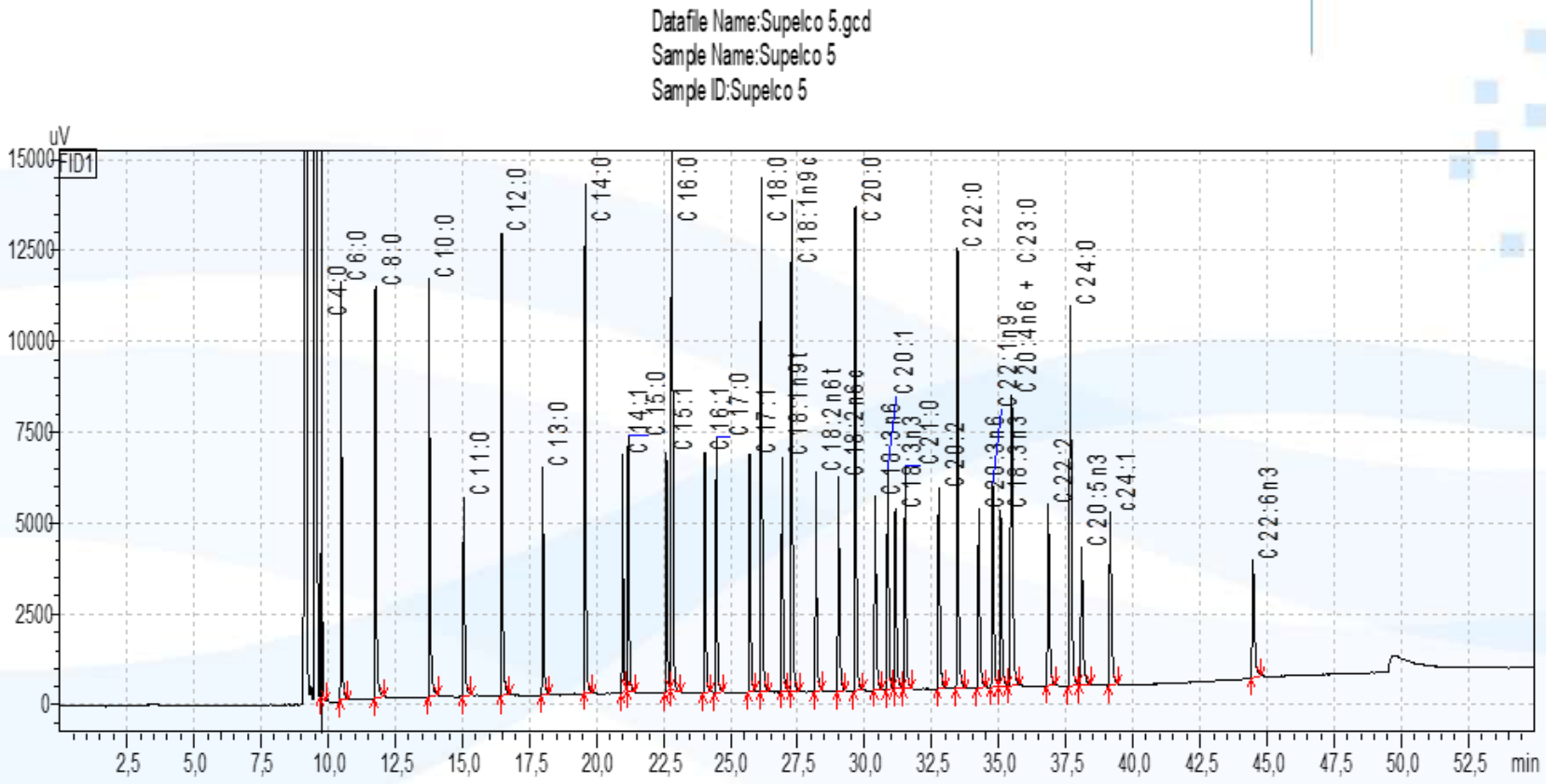


Table 1. Summary statistics (means ± SD) of the molar proportions of FAs (w/w %; mean ± SD) in conventional and Wagyu beef

Fatty acid name	Conventional (w/w %; mean ± SD)	Wagyu (w/w %; mean ± SD)	p-value
C10:0	0,046±0,011^{A}	0,034±0,009^{B}	0,001
C12:0	0,077±0,024^{A}	0,055±0,009^{B}	0,000
C13:0	0,008±0,012^{A}	0,004±0,005^{B}	0,008
C14:0	3,251±0,523^{a}	2,982±0,399^{b}	0,012
C14:1	0,371±0,266^{A}	0,794±0,494^{B}	0,000
C16:0	25,336±1,703^{A}	28,256±2,241^{B}	0,000
C16:1	1,844±0,925^{A}	3,810±1,940^{B}	0,000
C17:0	1,045±0,178^{A}	0,91±0,156^{B}	0,000
C18:0	27,264±8,260^{A}	15,813±7,004^{B}	0,000
C18:1n9t	4,289±0,746^{A}	1,268±0,394^{B}	0,000
C18:1n9c	30,877±7,631^{A}	43,340±6,049^{B}	0,000
C18:2n6t	0,001±0,004	0	0,321
C18:2n6c	4,517±2,027^{A}	1,857±0,339^{B}	0,000
C20:0	0,126±0,100^{A}	0,072±0,060^{B}	0,000
C18:3n6	0,016±0,015^{a}	0,020±0,011^{b}	0,01
C20:1	0,089±0,047^{A}	0,165±0,103^{B}	0,000
C18:3n3	0,134±0,038	0,133±0,029	0,814
C21:0	0,236±0,094	0,249±0,074	0,432
C20:2	0,035±0,032	0,031±0,013	0,147
C22:0	0,039±0,048^{A}	0,016±0,014^{B}	0,000
C20:3n6	0,073±0,107	0,077±0,040	0,634
C22:1n9	0,003±0,008^{A}	0^{B}	0,003
C20:4n6+C23:0	0,321±0,479^{A}	0,116±0,129^{B}	0,000

Table 4.6 Summary statistics (means ± SD) of the gravimetric FA concentration (mg/g; mean ± SD) in conventional and Wagyu beef

Fatty acid name	Conventional (mg/g; mean ± SD)	Wagyu (mg/g; mean ± SD)	P-value
C10:0	0,116±0,076	0,112±0,046	0,471
C12:0	0,187±0,125^{a}	0,163±0,070^{b}	0,022
C13:0	0,016±0,034^{a}	0,004±0,007^{b}	0,025
C14:0	8,013±5,095^{a}	9,034±4,200^{b}	0,021
C14:1	0,948±0,971^{A}	2,418±2,074^{B}	0,000
C16:0	64,141±37,047^{A}	83,977±35,843^{B}	0,000
C16:1	4,552±3,733^{A}	11,255±8,376^{B}	0,000
C17:0	2,672±1,684	2,773±1,378	0,339
C18:0	72,394±54,216^{A}	50,366±37,725^{B}	0,000
C18:1n9t	11,4791±7,394^{A}	4,121±2,446^{B}	0,000
C18:1n9c	78,614±49,777^{A}	128,968±57,055^{B}	0,000
C18:2n6t	0,002±0,0151	0	0,321
C18:2n6c	8,928±4,184^{A}	5,267±2,008^{B}	0,000
C20:0	0,298±0,381^{A}	0,230±0,264^{B}	0,002
C18:3n6	0,033±0,044^{a}	0,173±0,025^{b}	0,049
C20:1	0,228±0,196^{A}	0,505±0,436^{B}	0,000
C18:3n3	0,299±0,162^{A}	0,383±0,166^{B}	0,000
C21:0	0,565±0,416^{A}	0,755±0,425^{B}	0,002
C20:2	0,059±0,079^{a}	0,085±0,053^{b}	0,011
C22:0	0,036±0,047	0,039±0,040	0,691
C20:3n6	0,050±0,055^{a}	0,184±0,052^{b}	0,000
C22:1n9	0,002±0,004^{A}	0^{B}	0,002
C20:4n6+C23:0	0,191±0,215	0,192±0,123	0,955

Table 3 Main category of FAs and FA ratios of conventional and Wagyu beef

Fatty acid	Conventional (mean±SD)	Wagyu (mean±SD)	P-value
SFA	57,4±8,26	48,4±7,90	0,00
UFA	42,6±8,26	51,6±7,90	0,00
MUFA	37,5±8,48	49,4±7,92	0,00
PUFA	5,1±2,66	2,2±0,52	0,00
n-3	0,1±0,04	0,1±0,03	0,814
n-6	4,9±2,60	2,1±0,49	0,00
n-9	35,2±7,44	44,6±5,84	0,00
UFA/SFA	0,8±0,25	1,1±0,34	0,00
MUFA/SFA	0,7±0,25	1,1±0,33	0,00
PUFA/SFA	0,1±0,05	0,0±0,01	0,00

Are the fats in red meats all saturated?

Meat species	Fatty acid fraction (w/w%)			Reference
	SFA	MUFA	PUFA	
Beef				
Feedlot cattle	49.6±4.4	38.5±3.4	8.7±1.5	Webb, 2021; Webb & O'Neill, 2008; Webb et al, 1998; De Smet et al, 2000
Belgian white blue*	46.5±4.2	38.4±4.1	15.0±3.9	
Wagyu cattle	48,4±7,9	49,4±7,9	2,2±0,5	
Sheep				
Dorper sheep	52.8±1.9	43.9±1.3	3.3±0.5	Webb, 2021; Webb & Casey, 1995, a,b; Webb et al., 1998; Webb & O'Neill, 2008
Damara sheep	51.8±1.8	44.3±1.3	3.9±0.2	
Dorper sheep	50.8±2.9	42.7±3.7	4.7±0.9	
Merino sheep	52.2±3.9	40.0±3.2	5.21±1.1	
Dorper (Karoo grass)	52.9±4.5	43.1±3.6	3.6±0.9	
Dorper (Karoo browse)	54.7±2.9	41.3±1.9	3.7±1.5	
Goats				
Boer goats	54.7±2.2	41.9±0.9	3.4±0.4	Lee& Kannan, 2012; Webb & O'Neill, 2008 Tshabalala et al., 2003; Simela et al.,
Indigenous goats	53.6±2.8	42.5±1.1	3.9±0.4	

Are the fatty acids in SA beef unhealthy?

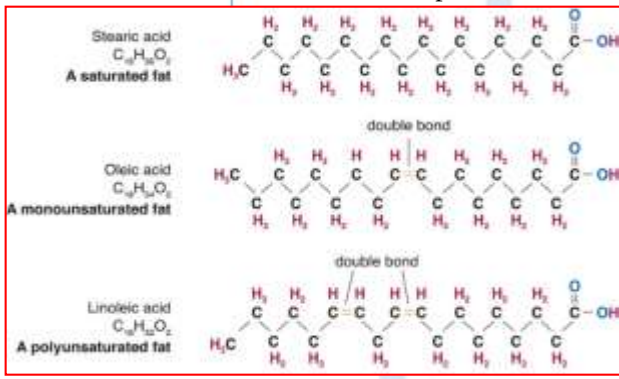
CLA, conjugated linoleic acid (C18:2c-9,t-11); MUFA, monounsaturated fatty acids (C18:1t-11 + C18:1c-9); PUFA, polyunsaturated fatty acids (sum of C18:2 isomers + sum of C18:3 isomers); SFA, saturated fatty acids (C14:0 + C16:0 + C18:0); TFA, trans-fatty acids. (Data from Webb, 2021)

Fatty acid	Molar % (w/w%; n=60)	Gravimetric content (mg /g meat; n=60)
C14:0	3.2 ± 0.569	6.36 ± 2.69
C16:0	25.97 ± 3.205	51.67 ± 21.900
C18:0	20.44 ± 5.589	40.01 ± 17.285
C18:1(n-9)t	4.82 ± 1.930	9.32 ± 4.8
C18:1(n-9)c	40.71 ± 8.793	83.06 ± 44.641
C18:2 (n-6)	3.02 ± 0.955	5.98 ± 3.057
C18:2 (t-9,t-12)	0.14 ± 0.134	0.29 ± 0.206
C18:2 (c-9,t-12)	0.12 ± 0.097	0.27 ± 0.270
C18:2 (t-9,c-12)	0.01 ± 0.029	0.03 ± 0.109
C18:2 (c-9,c-12)	3.75 ± 0.923	7.35 ± 2.724
C18:3 (n-3)	0.39 ± 0.183	0.86 ± 0.594
C18:3 (t-9,t-12,t-15)	0.09 ± 0.098	0.20 ± 0.159
C18:3 (c-9,t-12,c-15)	0.07 ± 0.059	0.17 ± 0.179
C18:3 (t-9,c-12,c-15)	0.12 ± 0.094	0.27 ± 0.241
C18:3 (c-9,c-12,c-15)	0.09 ± 0.064	0.22 ± 0.153
CLA (n-6)	1.43 ± 0.234	0.90 ± 0.738

Unhealthy

Neutral or Healthy

https://2012books.lardbucket.org/books/an-introduction-to-nutrition/s09-02-how-lipids-work.html



Are the fatty acids in Wagyu beef unhealthy?

- Myristic acid (C14:0) ~ low concentration (<3,5%) and negligible effect
- Palmitic acid (C16:0) ~ metabolised for energy, but cholesterolemic – pose some risk
- Stearic acid (C18:0) ~ cholesterol neutral & reduce CVD, CHD & ↓cancer risk in humans + stimulate FA β-oxidation
- Oleic acid & derivatives (C18:1, MUFA's >45%) ~ well-known reputation of cholesterol lowering effects
- FA's with >18C's occur in small concentrations with minor effects on CVD & CHD

Are the PUFA's in conventional and Wagyu meat unhealthy?

- The PUFA's in beef are essential fatty acids, which are incorporated mainly into muscle tissues rather than into adipose tissue

- PUFA's in phospholipids consist of the essential fatty acids:
  - C18:2n-6, C18:3n-3 and their long-chain derivatives namely
    - ecosapentaenoic acid (C20:5n-3; EPA)
    - decosahexaenoic acid (C22:6n-3; DHA)

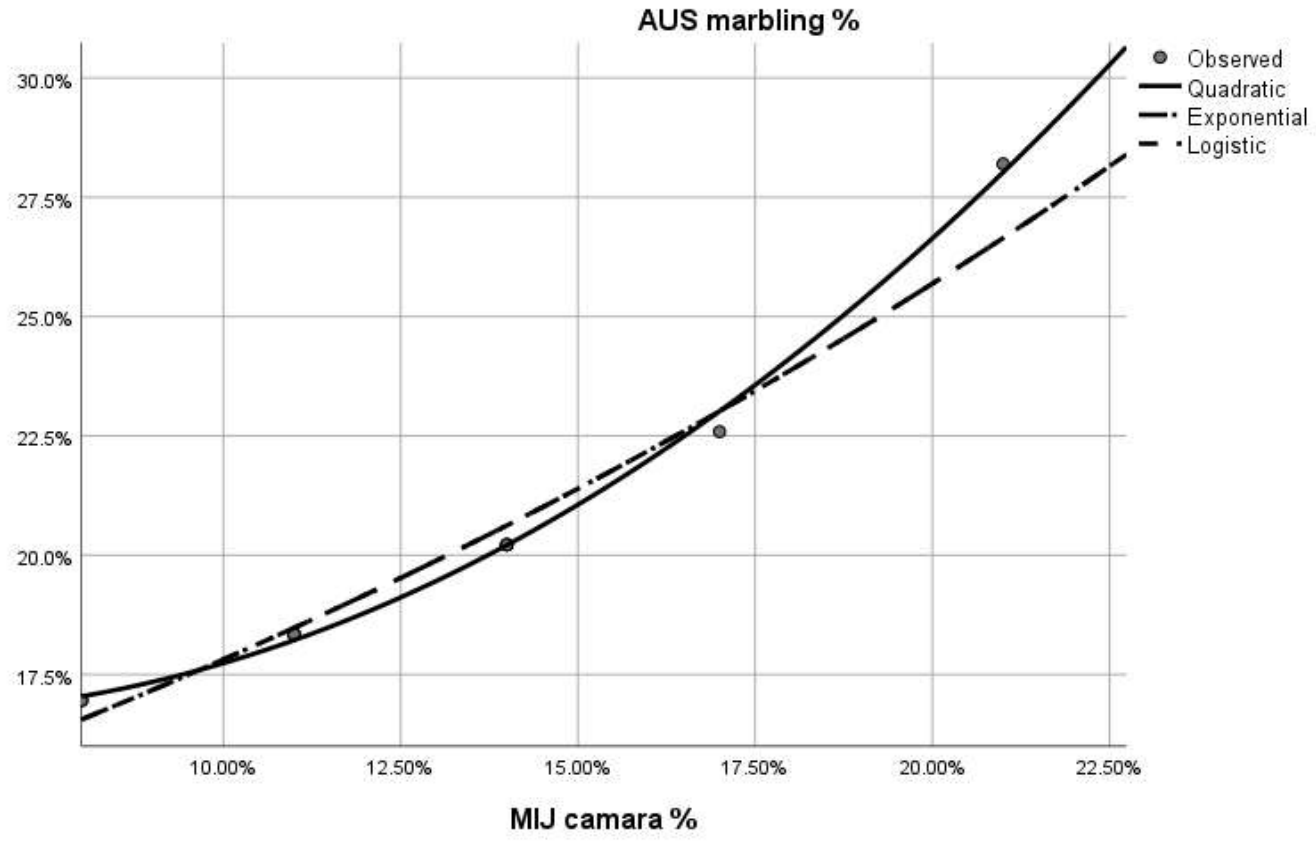
Does red meat contain much *trans*-fatty acids?

- TFA content of conventional and Wagyu beef is low (<4,2%)
- Most TFA's in beef are conjugated linoleic acids (CLA)
- CLA's are synthesised in rumen from 18 C PUFA's (e.g. rumenic acid > 90% of TFA's)
- CLA's are beneficial: (Yurawecza et al., 1998, (Lipids); McDonald, 2000, (The American College of Nutrition))
  - *Anti-oxidant properties*
  - *Anti-carcinogenic properties*
  - *Lowers cancer and diabetes risk*
  - *Lowers CVD & CHD*
  - *Improves the immune system and bone health*

Nutritional value of red meats (+ intra- and intermuscular fats)

- A highly digestible and high biological value protein source, *(e.g. digestibility of red meat (94%) > compared to whole wheat (86%) or beans (78%)*
- A relatively low fat and sodium (salt) content
- Contains antioxidants *(antioxidant and anti-inflammatory effects, and immunological, neurological, muscular and retinal functions)*
- Taurine, carnitine, carnosine and creatine are abundant in beef, but do not occur in plant-sourced foods.
- Excellent source of C18:0, C18:1 & long-chain omega-3 fatty acids *(improves dietary n-6/n-3 ratio)*

Marbling score and chemical fat content



Conclusions about Wagyu

1. Wagyu beef contains more intramusculalr fat, but not more unhealthy fatty acids
2. The FA composition between Wagyu and conventional feedlot cattle differs
   a) Similar FAs were detected in both, but:
   b) the amount of each FA differs
   c) More IMF is found in Wagyu than in conventional feedlot cattle
   d) The ratio of n-6/n-3 is lower in Wagyu beef than in conventional beef, which is favourable from a human health point of view
3. Actual fat % and marbling scores could be predicted accurately in Wagyu carcasses
4. MIJ camera marbling scores correlated well with actual fat percentages.

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