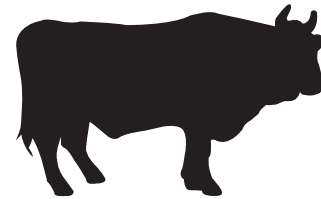


1

Research



What is Wagyu?

A JAPANESE BEEF CATTLE
BREED –DERIVE FROM NATIVE ASIAN CATTLE.

'WAGYU' REFERS TO ALL JAPANESE BEEF CATTLE.

*'Wa' means Japanese
and
'gyu' means cow*

A breed of Japanese cattle.

THE TENDER BEEF OBTAINED FROM WAGYU CATTLE, TYPICALLY CONTAINING A HIGH PERCENTAGE OF UNSATURATED FAT.

WAGYU WERE ORIGINALLY DRAFT ANIMALS USED IN AGRICULTURE, AND WERE SELECTED FOR THEIR PHYSICAL ENDURANCE.

This selection favored animals with more intra-muscular fat cells – ‘marbling’ – which provided a readily available energy source. Wagyu is a horned breed and the cattle are either black or red in color.

To view a short introductory video on Wagyu beef (courtesy of the Japanese Ministry of Agriculture, Forestry and Fisheries - MAFF)

WAGYU BREED HISTORY IN JAPAN

There is some evidence of genetic separation into the Wagyu genetic strain as much as 35000 years ago. Modern **Wagyu cattle are the result of crossing of the native cattle in Japan with imported breeds.** Crossing began in 1868 after the Meiji restoration in that year. The government wanted to introduce Western food habits and culture. Brown Swiss, Devon, Shorthorn, Simmental, Ayrshire, and Korean cattle were imported during this period. The infusions of these British, European and Asian breeds were closed to outside genetic infusions in 1910.

The variation of conformation within the Wagyu breed is greater than the variation across British and European breeds. The three major black strains Tajiri or Tajima, Fujiyoshi (Shimane) and Kedaka (Tottori) evolved due to regional geographic isolation in Japan. These breeding differences have produced a Japanese national herd that comprises 90% black cattle with the remainder being of the red strains Kochi and Kumamoto. For more information on the genetic diversity of the breed; click here (See PDF in the folder)

In Japan there are four breeds that are considered Wagyu and those are the Japanese Black (the predominant Wagyu exported to the U.S), Japanese Brown (In the U.S. referred to as Red Wagyu), Japanese Polled and Japanese Shorthorn. There is no Japanese Polled or Shorthorns being bred outside Japan. Wagyu strains were isolated according to prefecture (state) and breeds imported for crossing were not the same in each prefecture.

The production of Wagyu beef in Japan is highly regulated and progeny testing is mandatory. Only the very best proven genetics are kept for breeding. Realizing the value of their unique product, the Japanese Government banned the export of Wagyu and declared them a national living treasure. Zenwa is the Gov't held entity in Japan that oversees the WAGYU registry for Japanese Black, Brown, Polled and Shorthorn.

MEET OF FOUR JAPANESE BREEDS OF BEEF CATTLE



**JAPANESE
BLACK**



**JAPANESE
BROWN**



**JAPANESE
SHORTHORN**



**JAPANESE
POLLED**

JAPANESE BLACK >90% OF WAGYU TRADE IN JAPAN

TAJIMA

(Tajiri, also Nakadoi) Originated in the Tajima area of the Hyogo prefecture.

- Highest marbling line
- Finely marbled beef
 - Smaller frame
- Low birth weight
- Lower growth rates
- Good temperament

Kobe Beef and Matsuzaka Beef are famous names Tajima line cattle are descendants of Tajiri, a sire born in 1939 in the Mikata District of the Hyogo Prefecture. This is a large, influential sire-line to which almost all strains within the Hyogo Prefecture are related.

FUJIYOSHI (SHIMANE)

Itozakuraine developed in the Shimane prefecture

- Well-balanced cattle
- Good growth rates
- Good meat quality
- Quiet temperament
- Strong maternal ability in dams
- Good fertility rates

The bloodline started in the Tomadadistrict of the Okayama Prefecture Dai 7 Itozakurais probably the most famous of the Fujiyoshiline. He came from the Shimane district.

KEDAKA (TOTTORI)

Formed in the Tottori Prefecture

- Good growth
- Larger frame type
- Good topline
- Overall balance fine
- Loose skin

Descendants of the sire Kedakaborn in 1959. •Dai 20 Hirashigeis an important sire of the Kedakaline. •Semen is still used although the price is very high •He gained 84.7 points as an “Ikushu-Taroku” bull which was the highest honor in Japan of the time. •The number of registered sons of this bull is very high. These cattle were pack animals in the grain industry

THE JAPANESE BLACK

(Kuroge Washu) is a breed of Japanese beef cattle. It is one of six native Japanese cattle breeds,[4] and one of the four Japanese breeds known as wagyū, the others being the Japanese Brown, the Japanese Polled and the Japanese Shorthorn.[5]:420 All wagyū cattle derive from cross-breeding in the early twentieth century of native Japanese cattle with imported stock, mostly from Europe.[6]:5 In the case of the Japanese Black, the foreign influence was from European breeds including Braunvieh, Shorthorn, Devon, Simmental, Ayrshire and Holstein.[3]

History:

Cattle were brought to Japan from China at the same time as the cultivation of rice, in about the second century AD, in the Yayoi period.[2]:209 Until about the time of the Meiji Restoration in 1868, they were used only as draught animals, in agriculture, forestry, mining and for transport, and as a source of fertiliser. Milk consumption was unknown, and – for cultural and religious reasons – meat was not eaten. Cattle were highly prized and valuable, too expensive for a poor farmer to buy.[6]:2

Japan was effectively isolated from the rest of the world from 1635 until 1854; there was no possibility of intromission of foreign genes to the cattle population during this time. Between 1868, the year of the Meiji Restoration, and 1887, some 2600 foreign cattle were imported. At first there was little interest in cross-breeding these with native stock, but from about 1900 it became widespread. It ceased abruptly in 1910, when it was realised that, while the cross-breeds might be larger and have better dairy qualities, their working capacity and meat quality was lower. From 1919, the various heterogeneous regional populations that resulted from this brief period of cross-breeding were registered and selected as “Improved Japanese Cattle”. Four separate strains were characterised, based mainly on which type of foreign cattle had most influenced the hybrids, and were recognised as breeds in 1944. These were the four wagyūbreeds, the Japanese Black, the Japanese Brown, the Japanese Polled and the Japanese Shorthorn.[6]:8

The Japanese Black developed in south-western Japan, in the prefectures of Kyoto and Hyogo in the Kansai region; of Hiroshima, Okayama, Shimane, Tottori and Yamaguchi in the Chūgoku region; of Kagoshima and Oita on the island of Kyūshū; and of Ehime on the island of Shikoku.

Among the European breeds which influenced its development were Braunvieh and Simmental cattle from Switzerland, Ayrshire, Devon and Shorthorn stock from the United Kingdom, and Holstein cattle from Germany and the Netherlands.[6]:8

In 1960 the total breed population was reported to be over 1 800 000.[6]:23 In 2008 it was reported as about 707 000.[3] In 1999, the Japanese Black constituted about 93% of the national beef herd.

Tajima cattle[edit]

When registration of “Improved Japanese Cattle” began in 1919, there were notable variations between regional populations. It was left up to the prefectural administration to decide breed objectives. As a result, several different strains or sub-types developed with the Japanese Black population.[6]:8 One of these is the Tajima strain (Japanese: , Tajima Ushi or Tajima-gyu). Meat from animals of this strain only, raised only in Hyōgo Prefecture, may be approved for marketing as Kobe beef.[8]

TAJIRI OR TAJIMA

Originating from the Hyogo prefecture, these black cattle were originally used to pull carts and ploughs so the developed larger forequarters and lighter hindquarters. They are generally smaller framed with slower growth rates, but produce excellent meat quality with large eye muscle and superior marbling. They are thought to be ideal for the production of F1 cattle for slaughter. The Tajima bloodlines are generally regarded as producing the best quality meat in all of Japan.

FUJIYOSHI OR SHIMANE

From the Okayama prefecture are medium framed cattle with average growth rates and good meat quality.

TOTTORI OR KEDAKA

From the Tottori prefecture were originally pack animals in the grain industry, so they are larger animals with straight, strong back lines and generally good growth rates. However, their meat quality is variable. Best strain for milking ability. Combinations of all 3 lines are often used for Fullblood meat production.

KOCHI AND KUMAMOTO

The red lines, Kochi and Kumamoto, have been strongly influenced by Korean and European breeds, particularly Simmental. It is critical for Wagyu breeders to understand the characteristics of each line when cross breeding to produce higher quality Wagyu beef.

The production of Wagyu beef in Japan is highly regulated and progeny testing is mandatory. Only the very best proven genetics are kept for breeding. Realising the value of their unique product, the Japanese Government banned the export of Wagyu and declared them a national treasure. However in 1976, four bulls were exported to the United States and Wagyu were graded up from the American cow herd and was the beginning of a two decade window of Japanese genetics entering North America and filtering through to Australia and the rest of the world to today where Wagyu genetics exist on every continent even though actual numbers remain relatively low in comparison to the more popular beef breeds.

Beed formation



Wagyu Bull x Wagyu Cow = **FULLBLOOD**



Wagyu Bull x F2 Female = **F3 (87.5% WAGYU)**



Wagyu Bull x Base Cow = **F1 (50% WAGYU)**



Wagyu Bull x F3 Female = **F4 (93.75% WAGYU)**



Wagyu Bull x F1 Female = **F2 (75% WAGYU)**

WAGYU Breed History in USA

Wagyu cattle were first imported in 1975 when two black and two red bulls were imported Morris Whitney. \In 1989 the Japanese began to reduce their tariffs on imported beef and that encouraged U.S. producers to produce a high quality product for Japan. In the 1990's there were several importations of quality Wagyu. Most were black, but a few were Red Wagyu. These cattle have the greatest influence on the U.S. herd and those in many other countries.

Most US production was exported to Japan until 2003 when BSE was discovered and Japan and other countries stopped the import of beef for the U.S. However, chefs and others in the U.S. were aware of the superior eating quality of Wagyu and the domestic market then and now utilize much of the U.S. production.

US WAGYU TODAY

The American Wagyu Association was incorporated in Texas on March 14, 1990 and serves to register Wagyu cattle in the U.S., Canada and other countries. The Association headquarters are based in Post Falls, ID. The Association has a vibrant membership base and continues to promote and develop a sustainable industry here in the US.

The opportunities Wagyu beef can offer are endless. This industry caters for the breeder / feeder targeting the high end restaurant trade with highly marbled beef to the bull producer supplying the cow / calf rearer a crossbred alternative that will offer calving ease ability and premium carcass quality in a single cross which no other beef breed can come close too.

The Wagyu breed has a vital role to play in the US to increase the quality of red meat produced in the US that our health conscious consumer of the twenty first century is forever seeking.

Wagyu were originally draft animals used in cultivation, so they were selected for physical endurance. This selection favoured animals with more intra-muscular fat cells - marbling - which provided a readily available energy source. Japanese Wagyu derive from native Asian cattle, which were infused with British and European breeds in the late 1800's. Although the breed was closed to outside breed lines in 1910, regional isolation has produced a number of different lines with varying conformation.

It is important to recognise that the variation of conformation within the Wagyu breed is greater than the variation across British and European breeds. The three major black strains were evolved due to regional geographic isolation in Japan. These breeding differences have produced a Japanese national herd which comprises 90% black cattle with the remainder being red.

Japanese Style Feeding

TOTAL GROWTH MANAGEMENT TO MEET NUTRITIONAL REQUIREMENTS OF CATTLE AT EACH STAGE

1. SPECIALLY FORMULATED RATION
2. SELECTED FEED INGREDIENTS FOR FATTY ACID COMPOSITION AND FLAVOR
3. FEEDING UP TO 30 MONTH OLD
4. MINIMIZE CATTLE STRESS
5. MANAGING SMALL GROUP



0 – 3 MONTH GRAZING / STARTER RATION	3 – 13 MONTH WEANERS / GROWER RATION + HAY	14 – 30 MONTH FEEDERS/ FINISHER RATION + RICE STRAW
Early weaning to ensure their growth and getting ready for grain feeding program	Ensure the roughage consumption to develop rumen size and muscle growth	Restrict Vitamin A consumption and maximize feed consumption until last minutes to develop marbling
• CP ~ 22% • TDN 78% • ADF 14% • Ad-rib Hay Feeding • Target Consumption 0.5 ~ 2kg	• CP ~16% • TDN 76 ~ 78% • ADF 12% • High Roughage Contents(Pasture Hay, Alfalfa etc) • Target consumption 2 ~ 6kg (60% Ration, 40% Hay)	• CP ~12% • TDN 78%+ • ADF 12.5% • Roughage with No Vitamin A (Straw) • High Grain Contents (70% +) • Target consumption 7 ~ 10kg (80% Ration, 20% Straw)

- **0 – 3 month – Grazing/ Starter Ration**

- Early weaning to ensure their growth and getting ready for grain feeding program



- **3 – 13 month – Weaners/ Grower Ration + Hay**

- Ensure the roughage consumption to develop rumen size and muscle growth



- **14 – 30 month – Feeders/ Finisher Ration + Rice Straw**

- Restrict Vitamin A consumption and maximize feed consumption until last minutes to develop marbling



Key Point of Wagyu Feeding

START AT A YOUNG AGE

- Early weaning and supplement nutrition is essential for Wagyu calf growth because milk production of Wagyu cow is limited.
- Muscle development at young age will determine beef yield

DEVELOP RUMEN CONDITION WITH GOOD QUALITY ROUGHAGE

- Rumen conditioning at post weaning age (4 - 9month old) is essential to enhance high feed consumption for later stage
- Roughage consumption will increase rumen sizes and maintaining rumen bacteria population

MAINTAIN FEED CONSUMPTION

- Maintaining feed consumption as long as possible is key to increase marbling score. Irregular feed consumption will induce gastrointestinal problem and hence low meat quality

Wagyu Feed Ingredients

GRAIN

- Barley – High Crude Fibre
- Steam Flaked – High Digestibility
- Corn – High Energy, Good Fat
- Steam Flaked – High Digestibility
- Hominy Feed – High Crude Fiber

PROTEIN

- Soybean Meal – high in lysine
- Canola Meal

BY- PRODUCTS

- Wheat Bran – High Fiber
- OKARA (By-Products of Soy Milk) – High Crude Protein
- Nuts Husk – High Fiber
- Barley Husk – High Fiber

MINERAL

- Salt – Balance Mineral
- Lime Stone – Balance out P : Ca to 1 : 2 (prevention of Kidney Stone)

ROUGHAGE

- Grasses Hay (Ryegrass, Bermuda)
- Soft fiber and easy to digest
- Alfalfa Hay (Lucerne)
- High CP, Rich in Vitamin A
- Rice Straw/ Wheat Straw
- High Fiber
- No Vitamin A

Wagyu Feed Ration

INGREDIENTS	STARTER	GROWER	STARTER
CORN	25.00%	22.00%	35.00%
BARLEY	25.00%	22.00%	25.00%
WHEAT BRAN	10.00%	15.00%	19.00%
SOYBEAN MEAL	13.00%	11.00%	8.00%
BARLEY STRAW	00.00%	7.00%	00.00%
NUTS HUSK	00.00%	00.00%	3.00%
ALFALFA	15.00%	7.00%	0.00%
ALFALFA MEAL	10.00 %	10.00 %	0.00 %
WHEAT STRAW	00.00%	04.00%	4.00%
WHEAT HUSK	00.00%	00.00%	4.00%
LIMESTONE	1.00%	1.00%	1.00%
SALT	1.00%	1.00%	1.00%

Why Japanese Style??

MANAGING ANIMAL IN SMALL GROUP

Minimize variation in feed consumption
Managing by age group to control ration changes

MANAGING ANIMAL IN SHED

Minimize stress of environment effect
Minimize feed wastage

JAPANESE STYLE FEED RATION

Maximize marbling ability
Maximize eating quality by control fatty acid composition
(MUFA : BMW 57.1% VS Angus 49.6)

Health benefits

MANAGING ANIMAL IN SMALL GROUP

Wagyu beef has an abundant amount of marbling that leads to its superior taste, tenderness and juiciness. But is all of this marbling healthy?

As a matter of fact, when consumed as part of a well-balanced healthy diet, it is.

WAGYU BEEF IS HEALTHIER, NATURALLY

Research shows that the beef from long-fed Wagyu cattle naturally contains more Omega 3 and 6 fatty acids, as well as more monounsaturated fatty acids (the good fat) than other beef. The percentage of fatty acids affect the texture and “feel” of food in the mouth, particularly in meats. This is one of the genetic benefits of the Wagyu breed and one of the reasons why Wagyu beef is regarded as the finest, most exclusive beef produced in the world.

According to research, the protein in Wagyu beef can help maintain muscle while burning fat as it increases oxygen intake, energy production, and metabolic rate. It also helps maintain cell membranes and increases the body’s production of good prostaglandins – an unsaturated fatty acid that controls smooth muscle contraction, blood pressure, inflammation, and ideal body temperature. Additionally, the increased Omegas 3 and 6 help transport and metabolize triglycerides and cholesterol. Studies have shown that a higher monounsaturated fatty acid in the diet is associated with lower cardio vascular disease.

GOOD FOR YOU, GOOD FOR THE ENVIRONMENT

Not only will this nutritious, nutrient dense product satisfy your palate, you’ll have peace of mind knowing that Imperial Wagyu Beef partners with sustainable American family farmers who follow our strict, holistic production process.

The pride of Imperial Wagyu Beef is our USDA-approved all natural claim. Cattle are pasture raised before entering our nutritionist guided, 100% vegetarian feeding phase. They are never EVER given growth hormones or stimulants during their life. Imperial Wagyu Beef staff provide in-house grading and quality assurance during fabrication at USDA-inspected facilities. We produce some of the finest, all natural beef in the world by adhering to a natural production process that is better for everyone – from start to finish.

What Makes Wagyu Beef Smell So Good?

SCIENCE EXPLAINS

Japanese Wagyu beef has a sweet, coconut-like aroma. Scientists found 16 compounds associated with the smell, 10 of which are newly associated with the meat.

For about \$150 per pound, dedicated carnivores and food connoisseurs alike can get their forks on a luxury: Wagyu beef. Its trademark marbled flesh and soft texture have launched the meat into caviar-like status. And because its fat has a melting point lower than the average human body temperature, it melts in your mouth. The vast majority of the beef comes from Japanese Black cattle.

Part of its allure is the smell — a unique sweet, coconut-like aroma. New research from the Journal of Agricultural and Food Chemistry pinpoints 16 compounds that give it this distinct smell, 10 of which are newly associated with the meat. The strongest element: compounds derived from fatty acid.

Satsuki Inagaki, the lead author, says that while the smell of the beef is important, scientists weren't sure what was behind it. The paper points out that a previous study identified one compound that played a large role in the beef's smell, but that there was a potential flaw in the study: the meat wasn't cooked to an optimal temperature. In the recent research, conducted through Ogawa & Company, Ltd., the researchers analyzed several beef samples — along with Wagyu they looked at grass-fed Australian beef and U.S. beef as comparisons.

Alone, these compounds are not necessarily special. Inagaki says that some are also found in foods like tea, beer, citrus fruits, fennel and peanuts. The paper explains that one compound is associated with egg whites, and another with cooked chicken. What sets Wagyu beef apart from other foods, Inagaki explains, is the balance of these compounds.

The largest contributor to the Wagyu smell is a compound derived from fatty acid. There's some logic to this — there's a lot of fat in Wagyu beef. Looking at the flesh, or a photo of it at least, you can see flecks of fat in the meat. Stephen Smith, Texas A&M professor of meat science says, "To me, it's a sea of white with a few flecks of red." Smith explains that the cattle are bred and raised to have 30 to 40 percent fat in the muscle. He says that typical U.S. beef won't even come close to that. Iowa State University professor of animal science Joseph Sebraneck explains, "It's a genetic trait of these particular breeds of cattle to lay down more fat and give a different fatty acid composition." Smith adds that it's also partially dietary — the animals are typically fed corn and are kept alive longer than other types of cattle. High quality U.S. beef is from animals likely fed for 16 to 18 months, he says, while Wagyu beef is fed for at least 30 months. If you're trying to sink your teeth into this beef in the U.S., good luck. Wagyu, Smith says, means "Japanese style cattle," and hails from four Japanese breeds. There is "American Wagyu" from exported Japanese cattle, but it's difficult to say just how purely Wagyu it is.

You also might see it referred to as "Kobe beef" in the U.S., which is actually a specific type of Wagyu beef produced only in a particular area of Japan. It's unlikely you'll find it in the U.S. — there are only about 3,000 cattle each year that are certifiable Kobe beef, and until 2012, it wasn't shipped outside of Japan.

Why do you see restaurants advertising Kobe burgers then? Forbes.com writer Larry Olmstead wrote a popular series on Kobe beef. He explained on All Things Considered that under U.S. law, there aren't any specific rules as to what qualifies as Kobe beef, "so we can call pretty much anything we want Kobe."

To catch a whiff of this aromatic beef and a taste of its fatty acid, your best bet is probably to go to Japan.

<https://www.acs.org/content/acs/en/pressroom/presspacs/2017/acs-presspac-october-11-2017/key-odorants-in-worlds-most-expensive-beef-could-help-explain-it.html>

Key odorants in world's most expensive beef could help explain its allure

Renowned for its soft texture and characteristic flavor, Wagyu beef — often referred to as Kobe beef in the U.S. — has become one of the world's most sought-after meats. Now in a study appearing in the Journal of Agricultural and Food Chemistry, scientists report that they have detected several key odorants that contribute to the delicacy's alluring aroma.

Considered by some to be the champagne or caviar of beef, Wagyu is one of the rarest and most expensive meats in the world. It comes from Japanese Black cattle —which accounts for 95 percent of Wagyu — and three other species raised in Japan. The meat's distinctive marbling, juiciness and succulent taste are enhanced by its sweet aroma, known as “wagyuko,” that has been compared to coconut or fruit. In recent years, scientists have been trying to nail down what makes Wagyu aroma distinctive from other types of beef. In one study, researchers found that one particular compound appeared to have an important influence on the meat's aroma. But the samples used in that experiment were not cooked at the optimal temperature. To get a better sense of which odorants are responsible for Wagyu's aroma, Satsuki Inagaki and colleagues decided to try a different approach.

The researchers conducted an aroma extraction dilution analysis of Matsusaka-beef (a kind of Wagyu ribeye) and grass-fed Australia beef (loin). The team heated the samples to about 175 degrees Fahrenheit to simulate optimal cooking conditions. Using gas chromatography techniques, the research team detected 10 newly identified compounds in the Wagyu beef aroma, including one previously associated with cooked chicken that had an egg-white odor. Several Wagyu compounds were also found in the Australian beef aroma. However, the researchers say they likely don't smell alike because of the differing amounts of these constituents in the meats. The most potent odorant of Wagyu beef was a compound known to be derived from fatty acids present in the meat. The researchers say that this study not only clarifies which compounds are the main odorants in cooked Wagyu, it also helps confirm that particular types and amounts of unsaturated fatty acids in the beef play a key part in this aromatic process.

<https://www.acs.org/content/acs/en/pressroom/presspacs/2017/acs-presspac-october-11-2017/key-odorants-in-worlds-most-expensive-beef-could-help-explain-it.html>

Characteristics and Health Benefit of Highly Marbled Wagyu and Hanwoo Beef

This review addresses the characteristics and health benefit of highly marbled Wagyu and Hanwoo beef. Marbling of Wagyu and Hanwoo beef has been increased in Japan and Korea to meet domestic consumer preferences. Wagyu and Hanwoo cattle have high potential of accumulating intramuscular fat (IMF) and producing highly marbled beef. The IMF content varies depending on the feeding of time, finishing diet, and breed type. IMF increases when feeding time is increased. The rate of IMF increase in grain-fed cattle is faster than that in pasture-fed cattle. Fatty acid composition are also different depending on breeds. Highly marbled Wagyu and Hanwoo beef have higher proportions of monounsaturated fatty acid (MUFA) due to higher concentrations of oleic acid. MUFAs have little effect on total cholesterol. They are heart-healthy dietary fat because they can lower low-density lipoprotein (LDL)-cholesterol while increasing high-density lipoprotein (HDL)-cholesterol. Clinical trials have indicated that highly marbled beef does not increase LDL-cholesterol. This review also emphasizes that high oleic acid beef such as Wagyu and Hanwoo beef might be able to reduce risk factors for cardiovascular disease.

Interest in beef fat and fatty acids has been increasing, especially in highly marbled beef such as Wagyu and Hanwoo because fatty acids composition in the diet have impact on human health. Consumption of fat and cholesterol has been reported to be linked to cardiovascular disease, obesity, and cancer (Micha et al., 2010; Pan et al., 2012). Consequently, reduction of total fatty acid intake and replacement of SFA with PUFA have been recommended. However, not all SFA are linked to hyper-cholesterol or obesity. Ulbricht and Southgate (1991) have demonstrated that stearic acid has no effect on plasma cholesterol level and that oleic acid can lower serum cholesterol similar to PUFA. Furthermore, Pavan and Duckett (2013) have suggested that a higher proportion of oleic acid in beef is desirable because the consumption of high-oleic acid ground beef can increase HDL-cholesterol concentration (Gilmore et al., 2011).

According to Smith (2016), the amount of fat consumed in a typical portion of beef will not increase risk factors for cardiovascular disease. Clinical trials have demonstrated that ground beef containing elevated oleic acid can increase the concentration of HDL-cholesterol or at least has no negative effect on the concentration of HDL-cholesterol. In earlier research on oleic acid, the major MUFA in beef, Grundy et al.(1988) have found that it can lower LDL-cholesterol without affecting beneficial HDL-cholesterol. Recently, Lahey et al. (2014) have reported that MUFA can normalize or improve lipid metabolism and maintain the balance in cardiac muscle. These have implied that MUFA have little effect on total cholesterol and that they are heart-healthy dietary fat that can lower LDL-cholesterol and increase HDL-cholesterol (Lahey et al., 2014). This effect is repeatable when natural foods are used to supplement diets with oleic acid. In this regard, Smith (2016) have concluded that beef cattle should be raised under production conditions to increase the concentration of oleic acid in their edible tissue, i.e., by grain feeding over extended periods of time.

It is obvious that consumer in the world has an overwhelmingly negative attitude toward animal fats, especially saturated fat in meat for the last several decades (Ngapo and Dransfield, 2006; Williams and Droulez, 2010). According to Higgs (2000), the per capita decline in beef consumption in the US and other Western countries has been attributed in large part to animal fat phobia. Consumers have been warned to reduce saturated fat in their diet and to avoid meat cuts containing high fat content. These health recommendations are obviously in conflict with the health of highly marbled Wagyu and Hanwoo beef. Many research studies have shown that the IMF of Wagyu and Hanwoo beef contains a lot of MUFA that could prevent arteriosclerosis. Researches have also demonstrated that high-oleic acid ground beef may reduce risk factors for cardiovascular disease (Adams et al., 2010; Gilmore et al., 2011; Gilmore et al., 2013). Thus, although some consumers in Japan and Korea consider highly marbled Wagyu and Hanwoo beef as being unhealthy, there is no scientific evidence to indicate that beef that is high in oleic acid will increase risk factors for diseases (Smith, 2016).

Consequently, the role of animal fats in the diet should be re-evaluated because scientists around the globe increasingly doubt the validity of the so called “diet-heart hypothesis” (Barendse, 2014; Klurfeld, 2015; Ramsden et al., 2016; Siri-Tarino et al., 2010). It is now generally accepted that diets with low fat, high carbohydrate failed to curb obesity (Drewnowski, 2015). On the other hand, more recent functional medicine research studies have suggested that the intake of fat has positive effect on human health (Saito, 2016). It is essential to consume fats containing good quality fatty acids while reducing the consumption of food high in simple carbohydrates. Excessive intake of simple carbohydrates is detrimental to health because they have negative effects on the body (Yu et al., 2013). In this regard, inclusion of high fat foods with superior sensory properties in a balanced diet such as highly marbled Wagyu and Hanwoo beef is likely to gain wider acceptance as a well-being food in the near future.

CONCLUSIONS

In Japan and Korea, highly marbled Wagyu and Hanwoo cattle are greatly prized for traditional meat cooking methods. Their marbling has been increased to meet domestic consumer preferences. Many researches have shown that Wagyu and Hanwoo cattle have high potential of accumulating IMF and producing highly marbled beef. The beef quality grading system in both countries is primarily determined by marbling score with BMS and additionally adjusted by other carcass traits. Literature suggests that IMF content varies on the basis of feeding time, finishing diet, and breed type. Great attention has been paid to more accumulation of IMF to produce high quality grade beef. It is clear that IMF increases with increased feeding time. The rate of IMF increase in grain-fed cattle is faster than that in pasture-fed cattle. Literature also indicates that fatty acid composition varies between breeds. Highly marbled Wagyu and Hanwoo beef have higher proportions of MUFA due to higher concentrations of oleic acid. Many studies have shown that MUFAs have little effect on total cholesterol. They are heart-healthy dietary fat because they can lower LDL-cholesterol while increasing HDL-cholesterol. Clinical trials have also indicated that highly marbled beef does not increase LDL-cholesterol and that beef high in oleic acid can consistently increase HDL-cholesterol. Finally, literatures have concluded that high-oleic acid beef such as Wagyu and Hanwoo beef may reduce risk factors for cardiovascular diseases.

Myths & Facts: Japanese and American Wagyu

Joe Heitzeberg

Co-founder and CEO of Crowd Cow. I love our ranches and our customers. Follow me on Twitter at @jheitzeb.

We've been writing extensively about A5 Wagyu to give you some background on the Japanese beef and its well-earned reputation for rich marbling. One thing that's become increasingly evident in the course of our research and travels to Japan is the fact that there's a scary amount of myths out there about A5 Wagyu from Japan.

So we thought we'd do some myth-busting.

MYTH: WAGYU IS BANNED IN THE U.S.

FACT: It's true that Wagyu DNA and live animals are permanently banned for export from Japan, but the meat is not. Sometimes there's confusion because there was a ban on the meat for a while, too, but it ended in 2012 when exports resumed.

However, meat is still regulated under a strict quota and tariff system. You can only buy Japanese Wagyu in the U.S. in extremely limited supply.

As for live animals, there was a blip in the permanent ban between 1975 and 1997, when Japan did allow the export of a handful of animals. Those first few cattle began the seed stock of various breeding programs in the U.S. and beyond. That's why you might hear -- and rightly so -- that there are Fullblood Wagyu or Purebred Wagyu in the U.S. In fact, there are 26,000 of them (or 0.029% of the total 89.9 million cattle in the nation), and they all have to meet standards set by the American Wagyu Association.

The takeaway is this: 100% (by DNA) Wagyu animals are incredibly rare in the U.S. Authentic Wagyu beef from Japan is rarer.

MYTH: AMERICAN KOBE IS CHEAP-ISH AND EVERYWHERE. I SHOULD JUST BUY THAT FOR THE REAL JAPANESE BEEF EXPERIENCE!

FACT: First, Kobe and Wagyu aren't the same thing. We wrote a blog post on the distinction.

Second, the term "American Kobe" is a total crapshoot, and in most cases when you encounter it on a menu at your favorite burger joint, unfortunately means nothing. It's most certainly not real Kobe beef, which, according to our research, has only ever been served at 9 restaurants in the U.S. (as of July 2016), including the Wynn in Las Vegas, where it's featured for \$880 per pound. Not a typo.

Part of the reason this abuse of the term and marketing confusion has been able to go on so long is the price-prohibitiveness of Wagyu beef (the category into which Kobe falls, since both Kobe and A5 Wagyu beef arise from the Kuroge Washu Wagyu breed). Going for between \$200 and \$250 a pound at Japanese department stores and on Amazon Japan, few people are buying it. As a result, information about Wagyu beef from Japan is scarce.

The more information that's put out there about Japanese Wagyu, the more likely it is those mis-labelings and marketing sleight-of-hands will get brought into the light. Keep reading and writing, Wagyu devotees!

MYTH: IF IT'S LABELED "WAGYU", AND IT'S FROM JAPAN, YOU'RE GETTING HIGHLY MARBLED, LEGENDARY BEEF.

FACT: Not necessarily. The term "Wagyu" just means "Japanese Cow". That's the literal translation. There are four Wagyu breeds that are native to Japan, only one of which deserves much of a reputation for being "special." It's called Kuroge Washu.

Only Kuroge Washu Wagyu are genetically predisposed to the fine-grained intramuscular marbling that's made Japanese beef so famous. All "Kobe Beef" and other top luxury beef brands in Japan are derived exclusively from Kuroge Washu.

It's common for opportunistic importers to sell one of the less valuable breeds -- or even a non-native breed, which falls under the umbrella term Kokusan-gyu and label is as "Wagyu" in the U.S. They get a huge markup by (falsely) applying the Wagyu brand, after all. But it's a total ripoff to the consumer, because no other Japanese breed but Kuroge Washu can achieve A4 or A5 rank.

MYTH: IF IT'S LABELED "WAGYU" AND IT'S FROM A FARM IN THE USA, YOU'RE GETTING INCREDIBLY MARBLED, EXCEPTIONAL BEEF.

FACT: More often than not, you're getting a pretty ordinary beef, or a cross-breed between Wagyu DNA and something else, like Angus. Like I said above, only 0.029% of the total U.S. cattle count of 89.9 million qualifies as Fullblood or Purebred Wagyu (which are defined, by the way, as animals whose DNA are traceable to Japanese native breeds at 100% pure or above 93.75% pure, respectively). So it makes good sense that the \$26 "Wagyu" hamburger you bought is not actually likely to be from one of those animals. Instead, you're probably chomping into a cross-breed, whose DNA percentages are not monitored or enforced -- by anyone. Sometimes you'll see, "F1" which means 50% Wagyu by DNA (i.e., the first cross between Wagyu and something else, like Angus), but again, that's a voluntary and unregulated labeling program. The most likely scenario when you get a "Wagyu" hamburger at a restaurant, you're eating meat that has only trace amounts of Wagyu DNA from somewhere far up its family tree.

MYTH: IN JAPAN, WAGYU CATTLE ARE HAND-MASSAGED WHILE HAVING BEER AND SAKE FUNNELED DOWN THEIR THROATS, AS MOZART PLAYS IN THE BACKGROUND.

FACT: Nope. We asked all our producers this very question, and a few of them laughed at us. All unequivocally agreed that it's just a rumor that won't go away.

The cattle do, however, get their hair brushed, and this may be where the "massage" rumor originated. And I guess we can't vouch for every single cattle rancher in Japan when we say cows never receive an alcoholic boost from time to time. Feed programs among the top Wagyu farmers tend to be closed guarded secrets, so I guess anything is possible. It's not within the norm, though, our producers assure us. For their part, beer and sake is reserved for the farm staff.

MYTH: THE REASON WAGYU IS SO MARBLED IS BECAUSE THE ANIMALS ARE FORCE-FED.

FACT: NOPE, AGAIN.

We've been there to observe the feeding programs at the ranches we've partnered with, and we can unequivocally say there's no force-feeding at any of the farms we work with, ever.

The minimization of animal stress is actually a hallmark of Japanese cattle-raising, and there's a simple business logic to this: Force-feeding cattle would lead to unhealthy animals and poor-quality meat.

Ruminal acidosis (a condition that can occur if the pH of the cow's stomach changes) can be triggered by excessive feeding, and leads to -- at minimum -- high animal stress, and sometimes causes death. The farms we're working with proudly talk about their practically non-existent incidence of acidosis.

Because of the scarcity of land in Japan, grazing isn't possible and cattle are instead raised in "cowsheds," expansive, open-air barns where they are protected from the elements and can be closely tended to by ranch hands. If you ask any Japanese cattle farmer, this is how it's always been done in Japan, and they're extremely proud of how happy and calm their cows are.

"Film everything," they said.

The standard of cleanliness inside the cowsheds is absolutely pristine. The grounds are routinely cleaned and the soft soil and hay in the sheds are replaced frequently. It's a comfortable place to walk and sleep.

MYTH: IT'S ALL FAT! I'M NOT PAYING FOR FAT! WHERE'S THE BEEF!?

FACT: It's true that A5 Wagyu is among the most marbled beef on the planet, and the fine-grained marbling makes for some of the fattiest beef you can buy.

But it's good fats. One study from the Japan Livestock Industry Association, cited by CNN, says Wagyu has up to 30% more unsaturated fat than Angus cattle. And it's those unsaturated fats that makes Wagyu beef so full of rich, umami goodness -- that elusive fifth "primary taste." They also happen to help prevent heart disease and stroke.

There's a reason that A5 Wagyu from Japan is the most revered steak on the planet -- and it's got everything to do with that fat. So eat up! Enjoy your beautiful, exceptional (and, yes!) fatty A5 Wagyu beef.

Genetics of Marbling in Wagyu Revealed by the Melting Temperature of Intramuscular and Subcutaneous Lipids

Extreme marbling or intramuscular deposition of lipid is associated with Wagyu breeds and is therefore assumed to be largely inherited. However, even within 100% full blood Wagyu prepared under standard conditions, there is unpredictable scatter of the degree of marbling. Here, we evaluate melting temperature () of intramuscular fat as an alternative to visual scores of marbling. We show that “long fed” Wagyu generally has below body temperature but with a considerable range under standardized conditions. Individual sires have a major impact indicating that the variation is genetic rather than environmental or random error. In order to measure differences of lower marbling breeds and at shorter feeding periods, we have compared in subcutaneous fat samples from over the striploin. Supplementary feeding for 100 to 150 days leads to a rapid decrease in of 50% Red Wagyu (Akaushi) 50% European crosses, when compared to 100% European. This improvement indicates that the genetic effect of Wagyu is useful, predictable, and highly penetrant. Contemporaneous DNA extraction does not affect the measurement of . Thus, provenance can be traced and substitution can be eliminated in a simple and cost-effective manner.

1. INTRODUCTION

Marbling (or the accumulation of intramuscular fat) is the holy grail for beef producers, chefs, and their customers, but there is still no agreed definition and therefore no universal standard of measurement [1, 2]. So as to increase commercial returns based on superior taste and health benefits, there have been countless attempts to improve the reproducibility of visual and scanning scores but with limited success [1, 3].

Lipid profiles of highly marbled samples have revealed a high content of oleic acid and therefore a reduction in melting temperature () [4–6]. A precise and high throughput method for the measurement of exists [7] and is used here to interrogate the complex interplay between the genetic and environmental factors which can be optimized by the producer to the benefit of the health conscious consumer.

Because of the association of Wagyu breeds with high marbling and high oleic acid content, these traits can be assumed to be genetically determined and faithfully inherited [8, 9]. However, in spite of numerous studies [10–19], it has not been possible, hitherto, to identify markers which allow a breeder to quantify superior genetics in individual sires and dams. Some of the explanations for the slow progress include the following: (i) Complexity due to interactions of several metabolic processes and their regulatory mechanisms [6, 20, 21]. (ii) Contribution of many genes with small effects [22]. (iii) Uncontrolled environment factors associated with supplementary feeding [23–25]. (iv) Difficulty in quantifying marbling reproducibly [2]. (v) Unreliable tracing of meat from paddock to plate. (vi) Perception that fat is dangerous.

Recently it has been demonstrated that that low fat diets have not improved health [26]. In fact, higher oleic acid and therefore low are preferable in terms of lipid profiles [27–29]. This has led to the increasing popularity of the Wagyu brand worldwide. Not surprisingly, mislabeling is now rife resulting in the need to be able to confirm the provenance of retail samples.

Here we show that low is heritable and that the same fat sample can be used for the DNA tracing without affecting the measurement of .

2. MATERIALS AND METHODS

Postmortem samples of meat and fat were taken from carcasses of animals harvested for routine food production. Therefore, ethics approval was not required.

2.1. DATASET 1 FULL BLOOD WAGYU WITH IDENTIFIED SIRES

Two cohorts of Wagyu steers () were fed for days with a proprietary ration within the same commercial feedlot. One-gram samples of meat from the longissimus dorsi were taken from between the 10th and 11th rib. AUS-MEAT marbling score (MS) was scored between the 10th and 11th rib, with an average of 7.5 and a range from 2 to 11. Steers for the comparison of sires had their paternity confirmed by DNA testing [30]. Only one progeny of each dam was included so as to focus on the effect of the sire.

2.2. DATASET 2 EUROPEAN AND WAGYU CROSS BREEDS WITH VARIED FEED TIME

Melaleuka Stud, located in the Peel region of Western Australian, 100 km south of Perth, runs a variety of European breeds including Simmental, Gelbvieh, and Angus. This herd was selected to produce high quality beef on pasture, finished with 2 to 4 months of supplemental feeding. Black and Red Wagyu (full blood or pure bred) have been mated with these European breeds.

Calves stay on milk until 4 months of age when they are weaned and male calves are castrated. After weaning, they continue grazing Kikuyu and Ryegrass pasture until they reach 300 kg. Their feed is then supplemented with 9 mm EasyBeef pellets (Milne Feeds, Perth, Australia) ad libitum. The main ingredients of the EasyBeef pellets are lupins, barley, oats, wheat, and triticale. The nutritional composition, based on dry matter, is crude protein (min) 14.5%, metabolizable energy (est.) 11.0 MJ/kg., crude fiber (max) 20.0%, urea (max) 1.5%, and monensin 26.6 ppm. The feeders are considered ready for slaughter when they reach a weight of 400 kg and are slaughtered to match demand. Some animals were kept on feed longer to test the effect of increased feeding on and meat quality. The average live weight at slaughter for animals in this study was 461 kg, average age at slaughter was 15.4 months (range 8 to 23), and the average days on feed was 104 days (range 17 to 288). Body numbers from abattoirs were matched to farm records and pedigrees via their RFID tags, where possible identity was confirmed by in-house proprietary DNA testing [30].

Subcutaneous fat overlying the striploin (HAM number 2140) of these cattle was collected after boning and wet aging for 1 to 3 weeks.

2.3. FAT EXTRACTION AND MEASUREMENT

Intramuscular fat was extracted from dataset 1 samples by digestion with proteinase K. This method allows for simultaneous extraction of intramuscular fat and DNA from 0.5 gram samples of meat if the fat content is above 20%. The samples were incubated at 56°C, digested in a proteinase K mixture for 4 hours, and centrifuged at 10,000 ×g for 2 minutes to separate the fat from the dissolved DNA and protein solution. Fat was removed for measurement by pipette. DNA was extracted from the remaining mixture using a standard salting out method. Intramuscular fat content for many of the carcasses of dataset 2 was too low to allow extraction by the above method. Instead, fat was extracted from 1-gram samples of subcutaneous fat by rendering at 90°C for at least eight hours.

Samples from 17 sirloin steaks with intramuscular fat higher than 20% were used to determine whether fat separated during a DNA extraction process could be used for measurement. Fat was extracted by both digestion and rendering from the same samples and the measurements compared of all fat samples was determined in triplicate according to the thermocycler method [7], which is closely correlated to slip points, although the values are higher by 2°C for animal fat with a of 40°C.

3.1. IS AFFECTED BY SIRE

Samples were taken from long fed Wagyu steers differing only by sire and dam (dataset 1). The steers were fed, harvested, and tested in two cohorts two months apart. The cohorts did not differ significantly in feeding, genetics, or initial (as shown in Supplemental Table 1 in Supplementary Material available online at <https://doi.org/10.1155/2017/3948408>) and have therefore been combined for further analysis. and marble score were analyzed by sire for the three sires with more than ten progenies. As shown in Figure 1, of the progeny of Sire 2 fell consistently, whereas Sire 1 had little impact. In fact, 14 progenies of Sire 1 were above 37°C, compared to only 3 of Sire 2. The cross-product ratio is 104/6 or 17, as shown in Figure 1. This difference is highly significant (value < 0.01 by). It is noteworthy that there is more scatter with Sire 3 and all remaining sires.

Figure 1: distributions of Wagyu carcasses differ by sire. The melting temperature of intramuscular fat samples taken from between the 10th and 11th rib of 126 carcasses of full blood Wagyu steers. All animals were fed the same ration for days. Individual measurements of carcasses are grouped by sire (mean and standard deviation). Animals with either an uncertain sire or a sire with less than 10 progeny are grouped under “other” sires. Progeny of Sire 3 shows considerable scatter, whereas 8/11 of those of Sire 2 are below 37 degrees compared with 1/15 in the case of Sire 1. The difference between Sire 1 and Sire 2 is statistically significant with a chi-square statistic of 12.2 and thus a value < 0.01.

By contrast with , visual scores of marbling gave greater scatter, did not demonstrate a sire effect, and must be misleading in their present form.

3.2. IN WAGYU, FALLS WITH DAYS ON FEED AND PROPORTION OF WAGYU

Notwithstanding the genetic effects, there is also a major environmental effect on and marbling. results of dataset 2, grouped by proportion of black Wagyu, are shown in Figure 2. falls with increase in Wagyu and days on feed. Separating these two variables is not yet possible but, in the meanwhile, the results suggest that increasing the content of Wagyu genes allows the benefit of long feeding. The European cattle included in this study do not show the same benefit as the Wagyu.

Figure 2: decreases with feeding and increasing proportion of Wagyu ancestry. of subcutaneous fat samples over the loin of a mix of breeds and crossbreeds including Simmental, Gelbvieh, Angus, Dexter, and Wagyu. 176 samples (EU100) came from 100% European breeds fed for an average of 81 days. WY25, WY50, and WY75+ samples had 25%, 50%, and 75–100% Wagyu ancestry, respectively. There were 29 samples of WY25, 14 samples of WY50, and 11 samples of WY75+ with average days on feed of 103, 167, and 225, respectively.

Importantly, the benefits are seen with only 25% Wagyu, again emphasizing the high penetrance of the Wagyu genetics.

3.3. QUANTITATIVE EFFECT OF FEEDING

So as to address the complex interaction between genetics and environment, we compared two breed groups from dataset 2: a control group of purely European cattle (EU100) and the F1 Red Wagyu, also known as Akaushi and recorded as AK50. The dams have a similar breed composition and history to the EU100 control group. So as to avoid the complexity of sampling intramuscular fat before it is visible, we have relied on measurements of overlying subcutaneous fat. The effect of feeding is clear as shown in Figure 3. falls progressively even with only a 50% infusion of Akaushi.

Figure 3: Red Wagyu sired carcasses have lower for equivalent DOF. was measured for subcutaneous fat samples taken from the loins of 229 carcasses. The cattle were backgrounded on pasture and then fed on pellets until they reached a satisfactory weight and fatness. The results are grouped by days on feed and by breed of sire (European or Akaushi). The dams of all carcasses were European breeds. Breed and days on feed were both statistically significant influences on , with calculated by multiway ANOVA. The difference between the two groups was significant after only 51–100 days on feed.

3.4. DNA EXTRACTION DOES NOT INVALIDATE MEASUREMENT OF

In Figure 4 we show that extracting DNA with the proteinase K does not affect the measurement of on the same extract. Oxidation of the polyunsaturated fatty acids in the sample that may have occurred during rendering at 90°C did not have a measurable effect on the melting point, as expected [4, 31].

Figure 4: Simultaneous extraction of fat and DNA does not change . There is excellent correlation between measurements of fat harvested during DNA and extracted by rendering (Pearson's). There was no measurable bias (mean difference 0.13, SEM = 0.14). Either extraction method can be used for direct comparison without adjustment.

4. DISCUSSION

The intention of these studies is to resolve, in part, the manifest confusion facing producers and consumers of healthy beef.

It is clear that Wagyu beef is superior, as reflected by the commercial returns for highly marbled beef, but increasingly the brand is amenable to misuse.

A major issue is the lack of a reproducible measurement of the degree of marbling. Multiple and incompatible systems of scoring may have been retained perhaps to the advantage of some sectors. The measurement of is possible at successive stages of the production line so that quality can be confirmed. At the same time, DNA can be extracted so that provenance can be confirmed.

The difficulty faced by the breeder is even more important. Nonreproducible measurement obfuscates attempt to identify breeding values and therefore confound selection of superior sires. This issue becomes particularly important in an attempt to upgrade first crosses.

The present results show that even WY25 can have reduced but the scatter is substantial leading to lack of consistency. Future studies may identify those sires which are well suited to crossbreeding. So as to reduce the number of variables we sampled AK50 at differing days on feed. All had European dams. The initial results are promising in that there was a progressive decline in . Further work may define the preferred type and length of supplementary feeding. Importantly, there is also the potential to examine the controversies surrounding the use of grass versus grain. Whilst there is growing consumer demand for less intensive feeding and especially for “grass-fed,” there is also the perception that corn and perhaps other grains are necessary for extreme marbling. Given reproducible measurements, it should be possible to define acceptable compromises between supplementation, on the one hand, and tastiness and healthiness, on the other hand.

A major finding of this study is the difference in between the progeny of two full blood Wagyu sires. Sire 1 and Sire 2 share a paternal and a maternal grand sire and were imported from the same prefecture in Japan. Pedigree analysis alone would not predict large differences in lipid composition. It is noteworthy however that Sire 1 and Sire 2 are quite different in their C19 haplotypes, as described elsewhere [32]. A major issue remains unresolved. The degree of marbling and the lipid profile differ depending upon the site of sampling; as an approximation the intramuscular accumulation of lipid progress from the brisket backwards with the more caudal fat deposits having somewhat lower proportions of oleic acid and higher [33]. Therefore, comparable samples need to be from a fixed location. Even within the same muscle group there is variation depending upon sampling [34]. We recommend further experience using subcutaneous fat so that its utility can be extended. Ultimately, it should be possible to take in vivo samples so as to monitor changes with time, genetics, and feed.

CONFLICTS OF INTEREST

Collectively, the authors associated with the CY O'Connor ERADE Village Foundation have an interest in the work described in this manuscript as it forms part of the foundation's intellectual property.

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Making the Grade

The Japanese meat grading standards were last changed in 1988. Beef carcasses are now cut or "ribbed" between the sixth and seventh rib throughout Japan. There are three yield grades: A, B, and C - classified by yield percentages estimated by an equation.

There are five quality grades 1, 2, 3, 4 and 5. Based on marbling, meat colour and texture and fat colour and quality.

If Australia is going to raise cattle for export to Japan, it is important to have a fundamental understanding of the Japanese meat grading system.

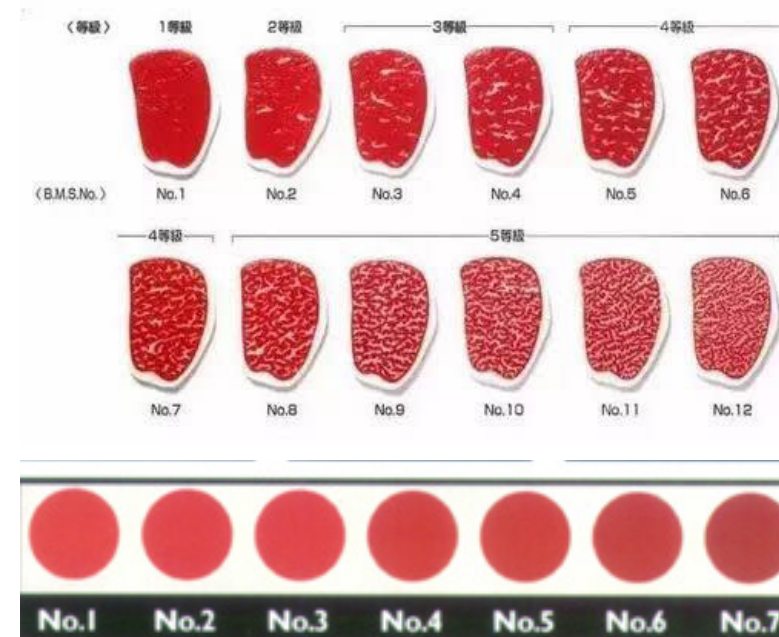
Yield Grade: Yield score is determined by an estimated cutability percentage that is calculated by an equation which includes four carcass measurements.

The measurements are obtained at the sixth and seventh rib section. The yield grading is absolutely objective, delivering an estimated yield percentage as follows:

- Grade A - 72% and above
- Grade B - 69% and above
- Grade C - under 69%
- Quality Grade
- The meat quality scores are determined in terms of beef marbling, meat colour and brightness, firmness and texture of meat, colour, lustre and quality of fat.

The relationship between beef marbling evaluation and classification of grade is as follows

- Meat colour is evaluated across seven continuous standards. The colour range is from No. 1 down to No. 7 and carcass colour graders are preferred in Grade 1 to Grade 3.
- Beef "brightness" is a factor in this evaluation. Firmness and texture of meat are evaluated by visual appraisal and classified into five grades.
- The firmness measure ranges from very good to inferior and the texture of the meat is evaluated on a scale from very fine to course.
- The colour, lustre and quality of fat is evaluated objectively against the Beef Fat Standards prepared as seven continuous stands, with grade No. 1 being the most desired.
- The remaining two factors, lustre and quality are evaluated simultaneously by visual appraisal.
- Carcass quality grade is determined by the lowest score for each of marbling, meat colour and fat colour assessments.



Why Wagyu is popular?

Marbling

Marbling is the visible form of intramuscular fat (IMF) which appears as fine flecks within the muscle. The presence of marbling has a very positive effect on the eating quality of beef in terms of tenderness, juiciness and flavor. Wagyu Fullblood100% has the highest propensity to marble of any beef breed. Through its higher marbling, Wagyu beef possesses a higher proportion of monounsaturated fat, compared to other beef.

Nutrition

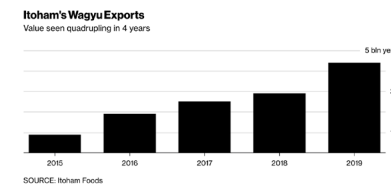
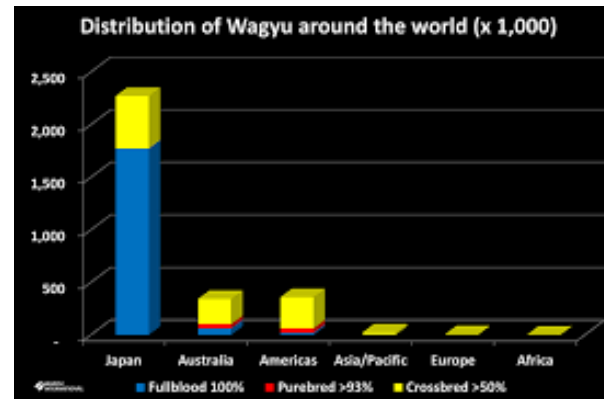
Research shows that the beef from long-fed Wagyu cattle naturally contains more Omega 3 and 6 fatty acids, as well as more monounsaturated fatty acids (the good fat) than other beef. The percentage of fatty acids affect the texture and “feel” of food in the mouth, particularly in meats. This is one of the genetic benefits of the Wagyu breed and one of the reasons why Wagyu beef is regarded as the finest, most exclusive beef produced in the world.



Distribution of Wagyu

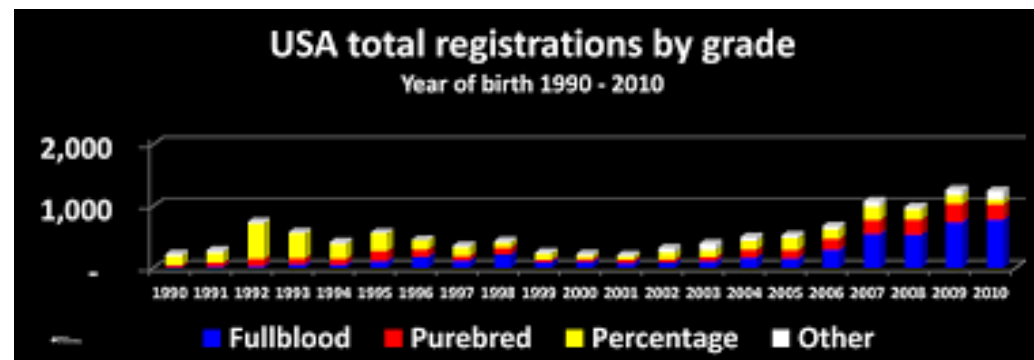
THERE ARE ALMOST TWO MILLION FULLBLOODWAGYU GLOBALLY. 96% ARE IN JAPAN AND THE SECOND HIGHEST POPULATION IS IN AUSTRALIA.

- The USA has the highest population of Purebred Wagyu (15/16) which have been bred up crossing Wagyu with local breeds.
- Australia has the largest population of registered Fullbloods outside Japan and is annually registering about three times the number in USA.
- Total Purebred Wagyu constitute less than 3% of the total Wagyu population.
- There are 1 million crossbred Wagyu and this includes 50% that are in Japan.
- The Americas, which include USA, Canada, Central and South America, comprise nearly 30% of all crossbreds. Australia contains fewer crossbred Wagyu than across the entire Americas. Gains have been most significant in Europe over the past 10 years with several Wagyu associations being formed to assist develop the breed. More recently there has been strong growth in China and Wagyu have started to develop in Russia. Total Wagyu, including crosses >50%, number 3 million head.



USA

THE NUMBER OF WAGYU REGISTRATIONS BY GRADE BY YEAR OF BIRTH BY THE AMERICAN WAGYU ASSOCIATION IS ILLUSTRATED (FROM AMERICAN WAGYU ASSOCIATION): IT WAS ESTIMATED IN 2006 THAT THERE WERE 24,000 WAGYU-CROSSES ON FEED AT ANY TIME OUT OF 10 TO 12 MILLION CATTLE IN TOTAL IN USA FEED-LOTS. REGISTRATION INFORMATION IS AVAILABLE FROM THE AMERICAN WAGYU ASSOCIATION WEBSITE.



Why so expensive?

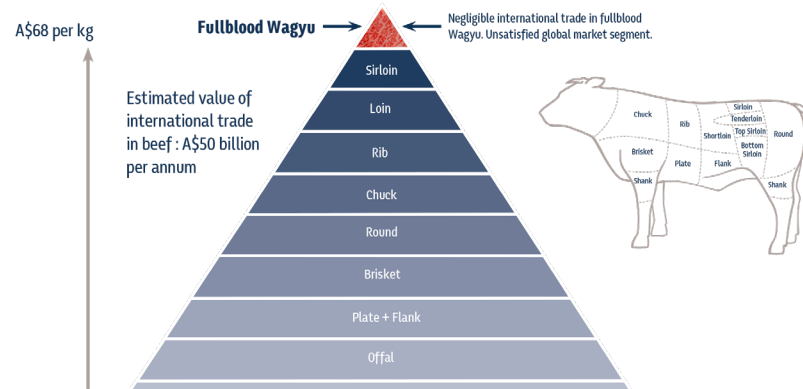
THE REARING METHOD IS WHAT MAKES THIS BEEF EXPENSIVE.

In Japan, to qualify for the Wagyu mark, the cattle have to be reared and fed according to strict guidelines. Breeding cattle and pregnant cows are grazed on pasture while calves are fed in a specific way, with special feed, to ensure that the meat has a lot of marbling. Young Wagyu calves are fed a milk replacer by hand and they get jackets to wear when the weather gets cold. They stay on a farm until they are seven months old before they are sent to auction to be sold to fattening farms. On the fattening farms, Wagyu cattle are raised in barns and are given names instead of just a number. They are kept on a diet of rice straws, whole crop silage and concentrate, and allowed to grow up to about 700kg, which takes about three years (for normal beef, it's 15 months). Every single cow has a birth certificate, which identifies its bloodline, so every piece of Japanese Wagyu steak can be traced back to a farm. There is a myth that cattle are fed on beer and massaged daily in Japan but this is not true. However, they are sometimes brushed with a stiff brush to increase blood circulation and to relieve stress. There is a Welsh Wagyu producer who does feed his cattle local craft beer and occasionally massages his cows though.

The price of Wagyu in the world

Wagyu Bargain					Other Bargain			
	Chuck	Brisket	Sirloin	Round	Chuck	Brisket	Sirloin	Round
Jul-16	2770.74	3032.96	4881.57	2779.48	1350.41	1686.92	2316.23	1350.41
Aug-16	2862.34	3005.68	4873.59	2853.38	1375.18	2109.80	2302.41	1415.49
Sep-16	2849.54	2974.02	4898.90	2867.32	1369.20	1729.29	2253.85	1426.99
Oct-16	2730.91	2975.99	4923.51	2905.96	1365.45	1671.80	2284.51	1378.58
Nov-16	2638.14	2906.14	4861.72	2700.95	1306.51	1666.64	2185.89	1293.95
Dec-16	2681.09	2614.65	4346.02	2556.03	1195.94	1535.96	2020.59	1238.93
Jan-17	2728.03	2827.45	4298.84	2644.52	1216.88	1582.74	2167.31	1284.48
Feb-17	2687.91	2768.27	4218.69	2667.82	1257.57	1587.03	2165.60	1281.68
Mar-17	2749.40	2713.28	4519.46	2504.57	1236.23	1593.45	2107.21	1280.38
Apr-17	2569.35	2668.17	4459.30	2511.70	1268.20	1799.37	2137.00	1342.32
May-17	2640.16	2567.39	4346.37	2555.26	1237.20	1714.29	2195.42	1301.89
Jun-17	2786.89	2676.40	4714.39	2578.18	1256.35	1596.02	2177.13	1289.09

Australian Bargain					U.S. Bargain					
	Chuck	Roll	Brisket	Sirloin	Round	Chuck	Roll	Brisket	Sirloin	Round
Jul-16	856.57		943.97	1621.36	808.50	1175.60		891.53	0.00	0.00
Aug-16	900.36		886.92	1688.73	869.00	1200.48		927.24	0.00	0.00
Sep-16	871.31		871.31	1191.38	849.08	1053.57		791.29	0.00	0.00
Oct-16	827.15		787.76	1628.04	744.00	1032.84		809.64	0.00	0.00
Nov-16	808.19		749.57	1461.45	778.88	967.32		745.38	0.00	0.00
Dec-16	742.58		699.58	1336.64	726.94	879.37		766.02	0.00	0.00
Jan-17	803.30		699.90	1367.99	691.95	958.39		779.44	0.00	0.00
Feb-17	783.47		695.08	1430.34	662.94	960.25		654.90	0.00	0.00
Mar-17	762.61		818.80	1408.82	710.43	971.32		690.36	0.00	0.00
Apr-17	790.57		737.04	1416.43	745.27	963.50		728.80	0.00	0.00
May-17	784.37		731.81	1407.01	739.89	950.14		687.33	0.00	0.00
Jun-17	814.38		761.18	1514.17	752.99	998.53		781.64	0.00	0.00



Price of different part



**AMERICAN WAGYU
BEEF BONELESS
STRIPLOIN**

\$ 649



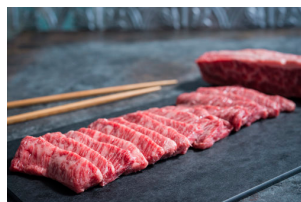
**AMERICAN WAGYU
BEEF BONELESS
RIBEYE**

\$ 699



**AMERICAN WAGYU
BEEF BONELESS
TENDERLOIN**

\$ 399



**AMERICAN WAGYU
BEEF BONELESS
CHUCK SHORT RIB**

\$ 189



**AMERICAN WAGYU
BEEF BONELESS
PEELED TRI TIP**

\$ 179



**AMERICAN WAGYU
BEEF BONELESS
FLANK**

\$ 169



**A5 JAPANESE WAGYU
BEEF PORTIONED
RIBEYE STEAKS
(2 PCS)**

\$ 299



**A5 JAPANESE WAGYU
BEEF PORTIONED
STRIPLOIN STEAKS
(2 PCS)**

\$ 299



**A5 JAPANESE WAGYU
BEEF PORTIONED
ASSORTMENT STEAKS
(2 PCS)**

\$ 299



**A5 JAPANESE WAGYU
BEEF WHOLE RIB CAP**

\$ 179



**A5 JAPANESE
WAGYU BEEF WHOLE
BONELESS RIBEYE**

\$ 1,199



**A5 JAPANESE
WAGYU BEEF WHOLE
BONELESS STRIPLOIN**

\$ 1,199

Ways to cook Wagyu

Steak



Sukiyaki



Shabushabu



Sashimi



Teppanyaki



Wagyu steak cooking times

STRIP LOIN STEAK	RARE	MEDIUM-RARE	MEDIUM	MEDIUM-WELL	WELL DONE
Temperature	52-54.5°C 125-130°F	54-60°C 130-140°F	60-65.5°C 140-150°F	65.5-71°C 150-160°F	71-76.5°C 160-170°F
1.5 cm Steak	2 mins	2-3 mins	3-4 mins	4-5 mins	5-6 mins
2cm Steak	2-3 mins	3-4 mins	4-5 mins	5-6 mins	6-7 mins
2.5cm Steak	3-4 mins	4-5 mins	6-7 mins	7-8 mins	8-9 mins
4cm Steak	5-6 mins	6-7 mins	8-9 mins	10-11 mins	11-12 mins

Wagyu roasting times

DONENESS	DESCRIPTION	MEAT THERMOMETER READING
Rare	Red with cold, soft centre	52-54.5°C / 125-130°F
Medium-Rare	Red with warm, somewhat firm centre	57-60°C / 135-140°F
Medium	Pink and firm throughout	60-65.5°C / 140-150°F
Medium-well	Pink line in centre, quite firm	65.5-68°C / 150-155°F
Well-done	Gray-brown throughout and completely firm	71-74°C / 160-165°F

The Big Four Meatpackers

ABOUT 35 MILLION CATTLE ARE SLAUGHTERED IN THE U.S. ANNUALLY BY 60 MAJOR BEEF-PACKING OPERATIONS PROCESSING AROUND 26 BILLION POUNDS OF BEEF. FOUR FIRMS CONTROL OVER 80 PERCENT OF ALL THE BEEF SLAUGHTERED.

1. TYSON FOODS, SPRINGDALE, ARK.

Daily slaughter capacity 28,700

U.S. market share 25 percent

Beef sales \$12.7 billion

Company overview

Tyson bought the world's largest supplier of premium beef and pork products, IBP Inc., in 2001. It's the second-largest pork and chicken packer in the U.S. and sells its products in 90 countries.

2. CARGILL MEAT SOLUTIONS CORP., WICHITA, KAN.

Daily slaughter capacity 29,000

U.S. market share 21 percent

Beef sales Cargill Meat Solutions would not release this data. Its parent company, Cargill Inc., reported \$88.3 billion in sales in 2009.

Company overview

Cargill Meat Solutions is one of 75 businesses under Cargill Inc., the largest privately-held corporation in the United States. Cargill runs the biggest flour-milling company in the world, is a leading corn syrup and soybean processor, and has cocoa and chocolate operations on four continents. It employs 131,000 people in 66 countries, including Canada, Mexico and China.

3. JBS USA, GREELEY, COLO.

Daily slaughter capacity 28,600

U.S. market share 18.5 percent

Beef sales \$9.2 billion

Company overview

JBS USA bought Swift (the-third largest packer) in 2007, then bought Smithfield (the fifth-largest packer and largest U.S. feedlot owner) in 2008, then bought Pilgrim's Pride, the largest chicken processor, in 2009. The company tried to buy National Beef Packing Co. in 2008, but the U.S. Department of Justice opposed the acquisition. The parent company, Brazil-based JBS S.A., is the largest beef packer in the world, with 54 processing plants on four continents.

4. NATIONAL BEEF PACKING CO., LLC KANSAS CITY, MO.

Daily slaughter capacity 14,000

U.S. market share 10.5 percent

Beef sales \$5.4 billion

Company overview

National Beef started as a single plant in Kansas in 1992. Its other main product is leather.

Sources: All numbers are for 2009. Slaughter capacity from "Feedstuffs" 2011 Reference Issue and Buyers Guide. Market share and beef sales from A Value Chain Analysis of the U.S. Beef and Dairy Industries, Center on Globalization Governance and Competitiveness, Duke University. Market share numbers for the four companies add up to 75 percent in the Duke report, although the more commonly used figure is 81 percent. Numbers differ due to varying sources used to collect this data, which is not reported by the USDA.