

Executive Summary

This report provides a detailed metabolomic and nutritional comparison of Kinloch Farms beef samples (Ribeye Winter 2024, Ribeye Fall 2024, and Liver Winter 2024) against grass-fed and grain-fed benchmark beef. The analysis covers fatty acids, vitamins, antioxidants, minerals, and macronutrients.

Fatty Acids

- **Omega-6:** Ribeye Winter had higher omega-6 levels than Ribeye Fall; however, this was counteracted by higher levels of omega-3s. It is likely that the conserved forages were higher in both omega-6s and omega-3s, which is in the case on some conserved forages (e.g., alfalfa hay). Kinloch samples were lower in omega-6 compared to grain-fed and comparable to or higher than grass-fed benchmarks.
- **Omega-3:** Ribeye Winter and Liver exceeded grass-fed benchmarks, while all Kinloch samples were higher than grain-fed.
- **Omega-6/3 Ratio:** All Kinloch samples had lower ratios than both benchmarks, with Ribeye Winter showing the most favorable profile.

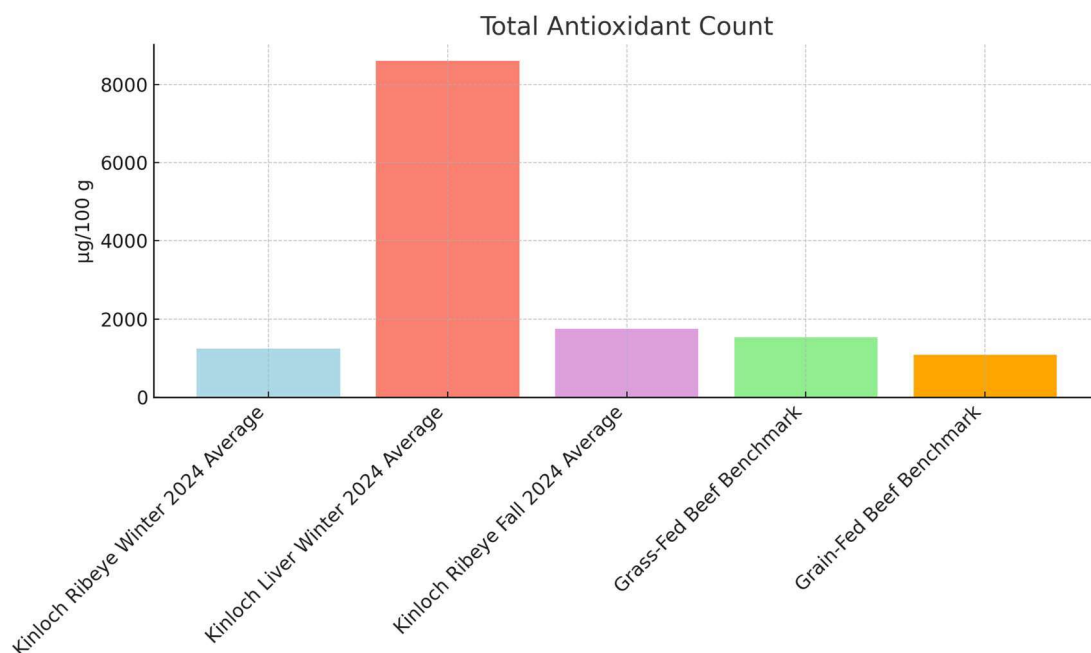
Vitamins

- **Vitamin B2:** Ribeye Winter had higher levels than Fall; both were comparable to benchmarks but lower than Liver.
- **Vitamin B3:** Ribeye Fall exceeded Winter, likely due to diet (fresh pasture vs. hay as precursors to B3 are higher in fresh pastures). Kinloch values were like benchmarks, but below liver levels. The liver is known to be very rich in b-vitamins.
- **Vitamin B12:** Ribeye Winter and Liver exceeded both benchmarks; Ribeye Fall fell below.

Antioxidant Compounds

- **Hippuric Acid:** A major antioxidant in mammals including cattle and humans. Highest in Ribeye Fall; all Kinloch samples except Ribeye Winter exceeded the grain-fed benchmark. Since this compound is produced from polyphenols in forages, when animals are consuming fresh forages, these levels are higher than when animals are on conserved forages or consuming total mixed rations in feedlots.

- **p-Cresol Sulfate:** Highest in Ribeye Fall; Ribeye Winter and Liver Winter were below benchmarks. Like hippuric acid, this compound is also an antioxidant produced from polyphenols by gut bacteria.
- **Quercetin 3-O-robinobioside:** Minimal in all, highest in Ribeye Fall.
- **trans-Ferulic Acid:** Detected primarily in Liver; Ribeye Winter had none.
- **Total Antioxidant Count:** Highest in Liver; however, there was a drop in phytochemical antioxidants in the Winter vs Fall Kinloch samples, there was about a 40% drop in phytochemicals. This mirrors the reductions in vitamins. It is known that fresh forages contain more phytochemicals and vitamin precursors. We have found that feeding phytochemically-rich feed like alfalfa or hay from plant-diverse fields can maintain the levels somewhat, but a drop in phytochemicals and vitamins when animals are on conserved forages coming out of the Winter appears inevitable.



Minerals

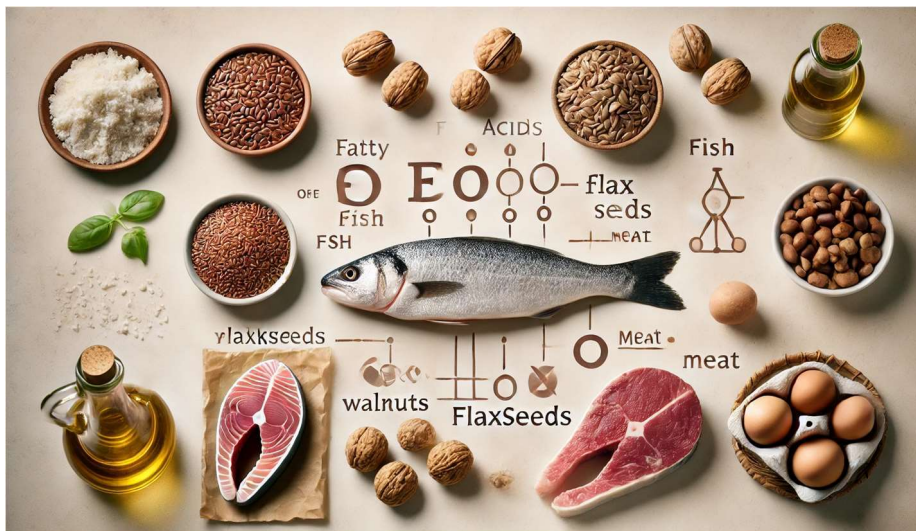
- **Calcium:** Highest in Ribeye Fall, followed by Ribeye Winter; both ribeye samples surpassed benchmarks.
- **Iron:** Highest in Liver; all Kinloch samples were at or above benchmark levels.

- **Magnesium:** Stable across all samples; Kinloch samples slightly exceeded benchmarks.
- **Zinc:** Similar across all samples with minimal variation; Kinloch values were consistent with benchmarks.
- **Seasonality:** much like the vitamins and phytochemicals, minerals were typically lower in the Winter vs Fall ribeye.

Macronutrients

- **Protein:** Ribeye Fall had the highest protein content among Kinloch samples, exceeding benchmarks.
- **Fat:** Highest in Ribeye Winter, lowest in Liver; Kinloch Ribeye samples were leaner than both benchmarks.

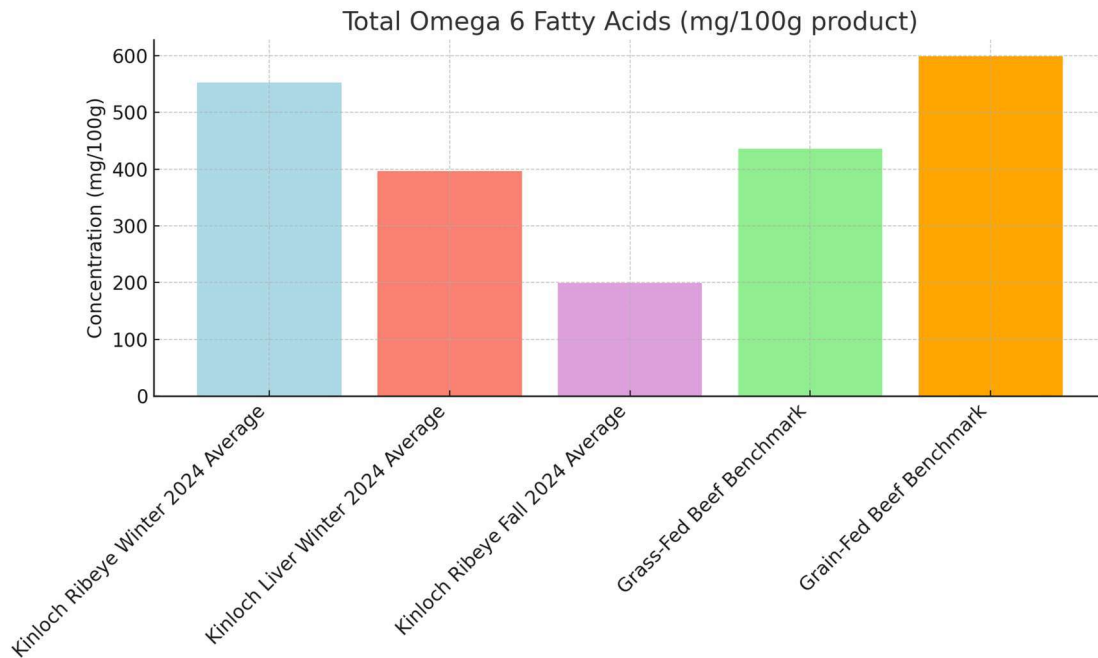
Fatty acid concentrations



Introduction

In this section, we compare the fatty acid composition of Kinloch Ribeye and Liver across different times periods to two benchmark meats: Grass-fed and Grain-fed Beef. We quantified total omega-3, omega-6, and the omega-6 to omega-3 ratio to evaluate the nutritional balance of these fats. These comparisons are important for assessing dietary impacts on inflammation and cardiovascular health.

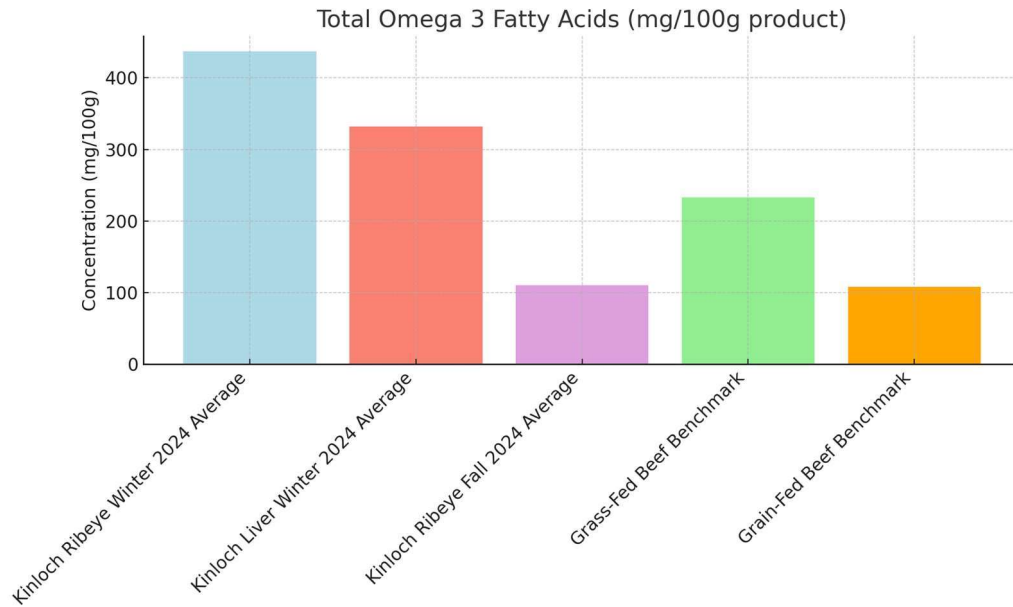
Total Omega 6



The Kinloch Ribeye Winter 2024 sample had significantly higher omega-6 levels than the Ribeye Fall 2024 sample. Compared to benchmarks, the Kinloch samples generally had lower omega-6 than grain-fed beef and were comparable or higher than grass-fed beef.

Health Benefit: Reducing omega 6 intake may help support a healthier inflammatory response.

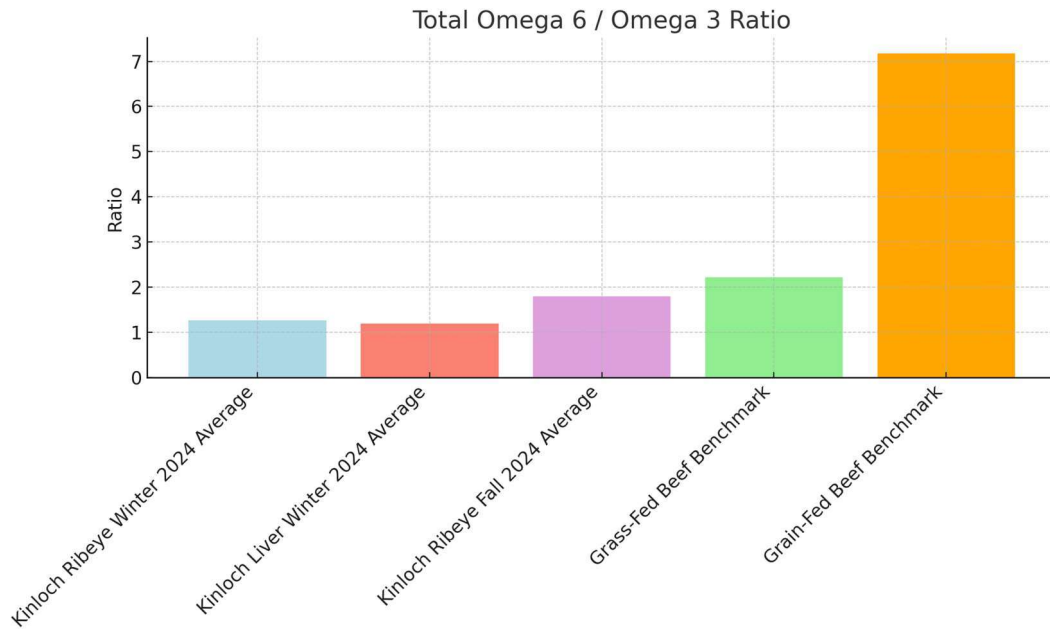
Total Omega 3



Ribeye Winter 2024 had substantially higher omega-3 than Ribeye Fall 2024 in terms of absolute quantities as this sample was fattier than the other samples. All Kinloch samples surpassed the grain-fed benchmark, and Ribeye Winter and Liver Winter also exceeded the grass-fed benchmark.

Health Benefit: Omega 3 fatty acids are known to promote heart and brain health.

Total Omega 6/3 Ratio



The omega-6 to omega-3 ratio was lower in the Ribeye Winter sample compared to the Fall sample, indicating a more favorable balance. All Kinloch beef samples exhibited better omega-6 to omega-3 ratios than both grass-fed and especially grain-fed benchmarks. Since fat turns over slowly, the omega 6:3 ratio is typically better maintained in winter beef compared to nutrients such as phytochemicals and vitamins.

Health Benefit: A lower omega-6 to omega-3 ratio is associated with reduced inflammation and a lower risk of chronic diseases such as heart disease and arthritis. Diets closer to a 1:1 or 2:1 ratio are considered more beneficial compared to the typical Western diet, which often exceeds 10:1.

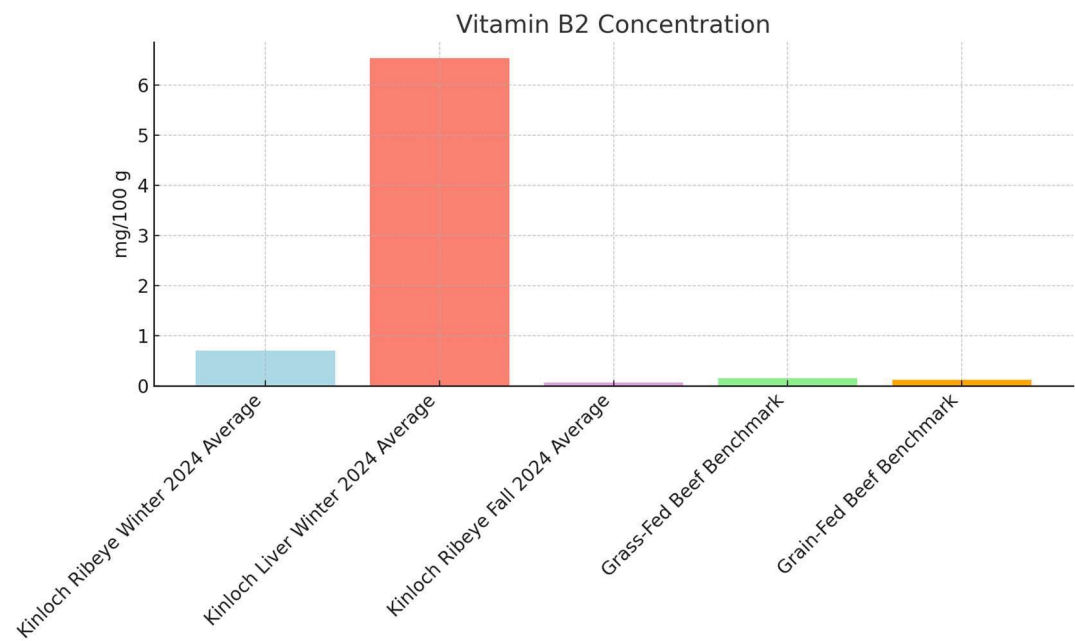
Vitamin Concentrations



Introduction

This section presents a comparative analysis of key B vitamin concentrations—B2, B3, and B12—in Kinloch Ribeye and Liver across different times periods versus Grass-fed and Grain-fed Beef benchmarks. These data allow us to assess the nutritional value of beef as a source of essential vitamins.

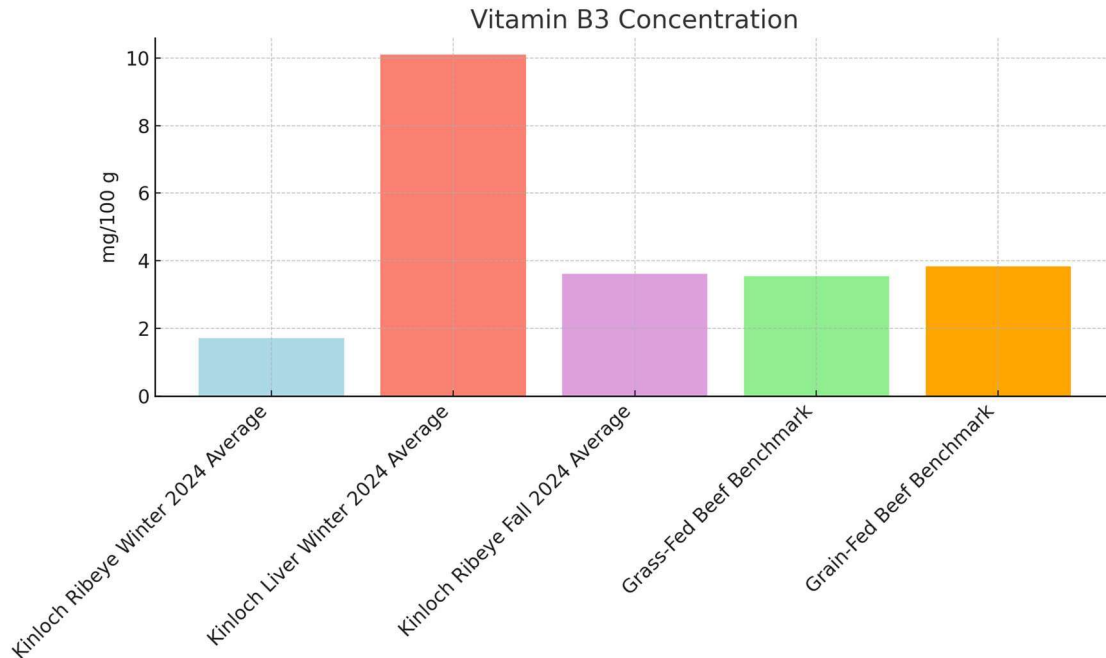
Vitamin B2



The Ribeye Winter sample shows higher Vitamin B2 levels than Ribeye Fall. While both Ribeye samples are lower in B2 compared to the liver, they exceed or match the levels seen in standard grass-fed and grain-fed beef.

Health Benefit: Vitamin B2 (riboflavin) supports energy production and cellular function.

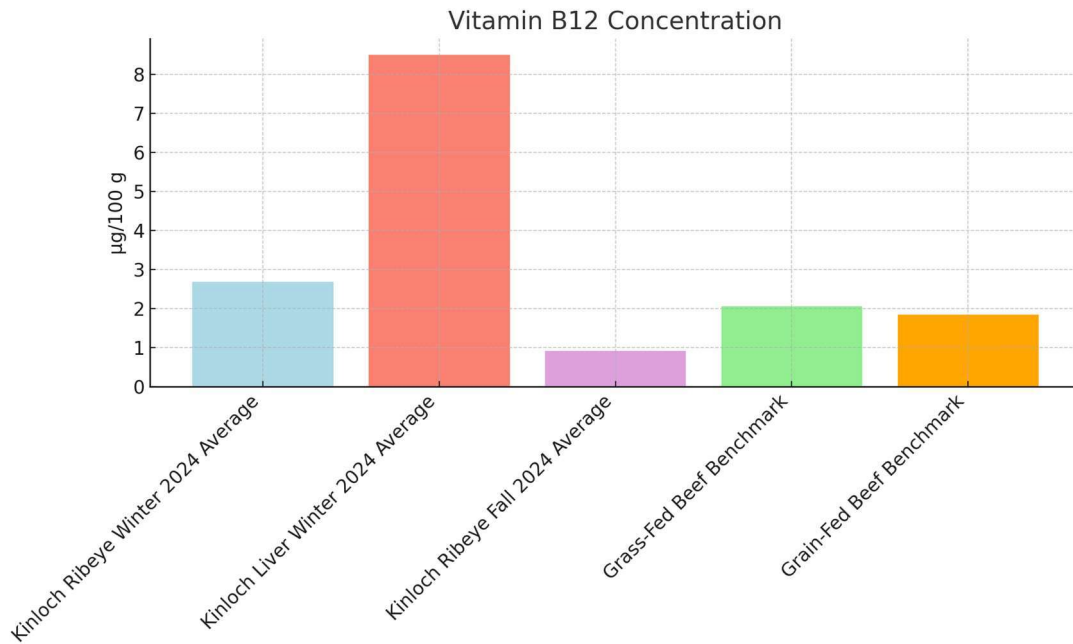
Vitamin B3



Ribeye Winter has lower Vitamin B3 than Ribeye Fall, likely due to the animals consuming conserved forages such as hay during the winter, which are lower in precursors for niacin synthesis. Both ribeye samples have comparable B3 concentrations to grass-fed and grain-fed benchmarks, though still well below liver levels.

Health Benefit: Vitamin B3 (niacin) helps convert food into energy and supports the nervous system.

Vitamin B12



Ribeye Winter shows more Vitamin B12 than Ribeye Fall. All Kinloch samples surpass benchmark levels except Ribeye Fall, which falls below both grass-fed and grain-fed references. Vitamin B12, while being water soluble, can be stored for long periods of time unlike vitamins B1-B6, which are much more responsive to dietary intakes and presence of precursors in forages.

Health Benefit: Vitamin B12 is essential for red blood cell formation and neurological function.

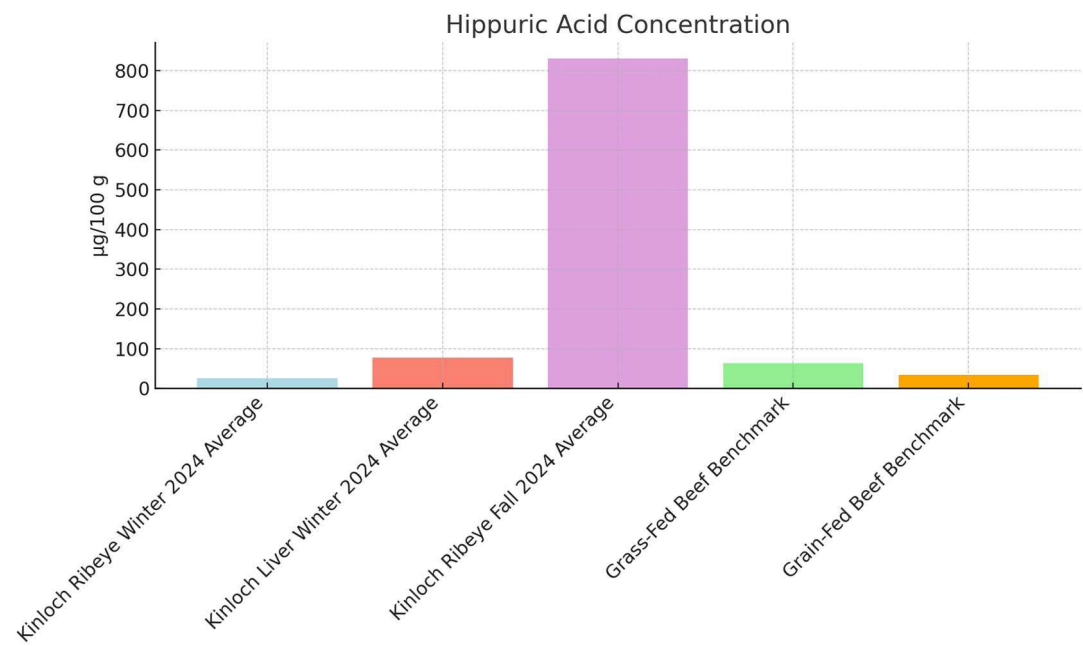
Antioxidant Concentrations



Introduction

We evaluated the antioxidant profiles of Kinloch Ribeye and Liver across different times periods in comparison to Grass-fed and Grain-fed beef benchmarks. Compounds such Hippuric acid, p-Cresol sulfate, trans Ferulic acid, and Quercetin 3-O-robinobioside were measured. This section provides insights into the bioactive compounds present in beef that may support cellular health and inflammation regulation.

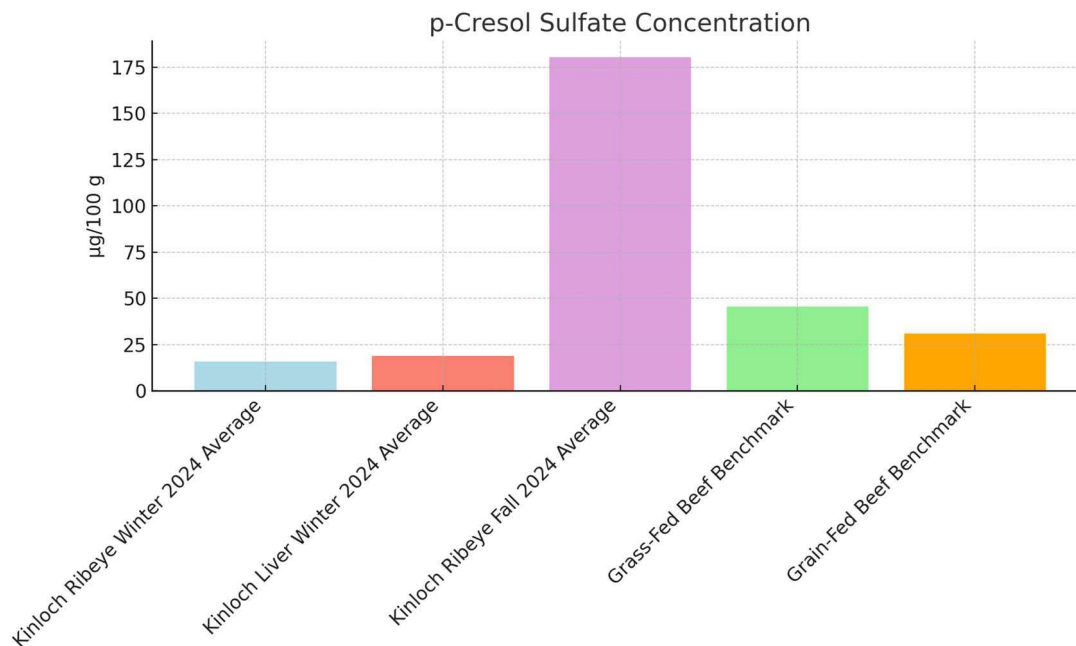
Hippuric Acid



Ribeye Fall shows the highest hippuric acid concentration by a large margin, followed by Liver and Ribeye Winter. All Kinloch samples exceed or match the grain-fed benchmark, while Ribeye Fall and Liver Winter also surpasses grass-fed levels.

Health Benefit: Acts as a biomarker of polyphenol intake and is associated with antioxidant and anti-inflammatory effects.

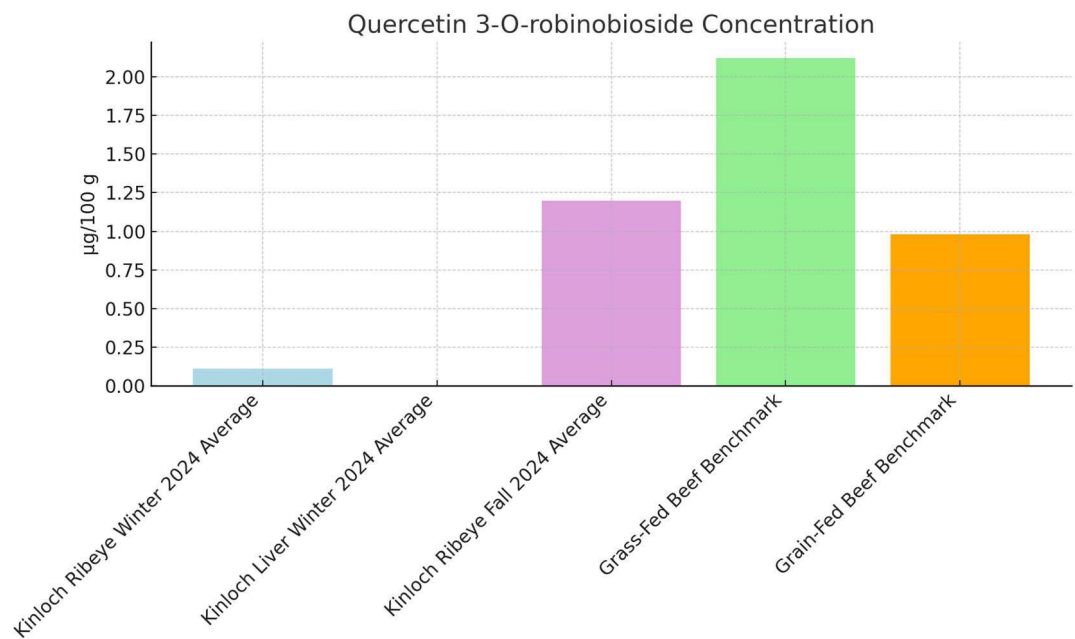
p-Cresol Sulfate



p-Cresol sulfate is highest in Ribeye Fall, and lowest in Ribeye Winter. Ribeye Winter and Liver Winter fall below both benchmarks while Ribeye Fall exceeds both benchmarks.

Health Benefit: p-Cresol Sulfate may serve as a marker of microbial fermentation and dietary fiber metabolism, offering insights into gut health and microbial diversity when present at physiological levels

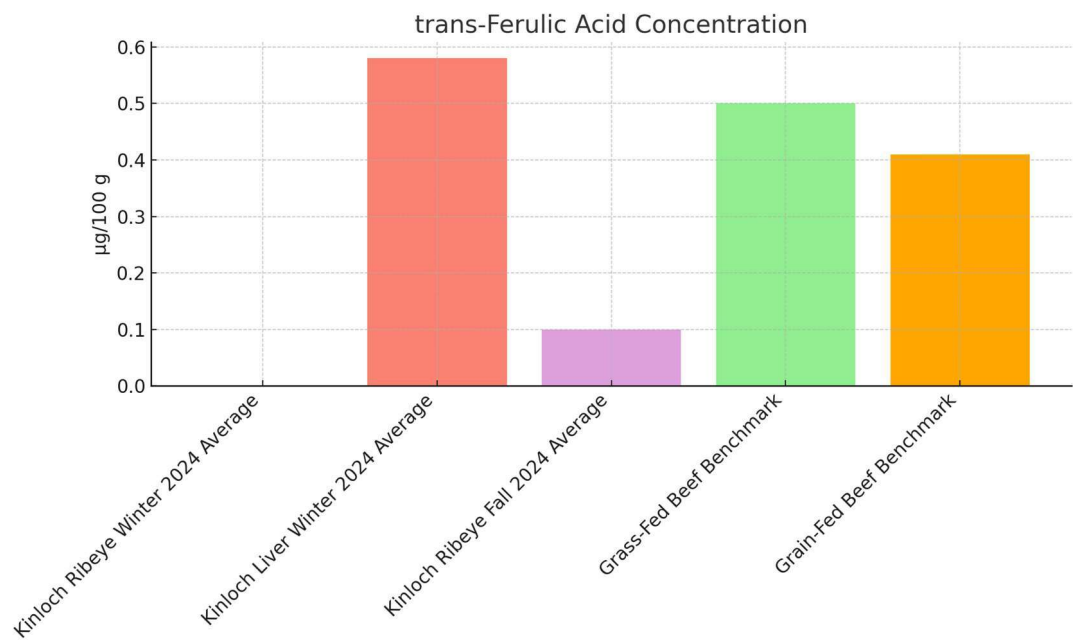
Quercetin 3-O-robinobioside



Quercetin levels are minimal across most samples, with Ribeye Fall showing the highest amount among the Kinloch cuts. All samples fall below the grass-fed benchmark, but Ribeye Fall exceeds the grain-fed benchmark.

Health Benefit: A flavonoid derivative with antioxidant properties that may support vascular and immune health.

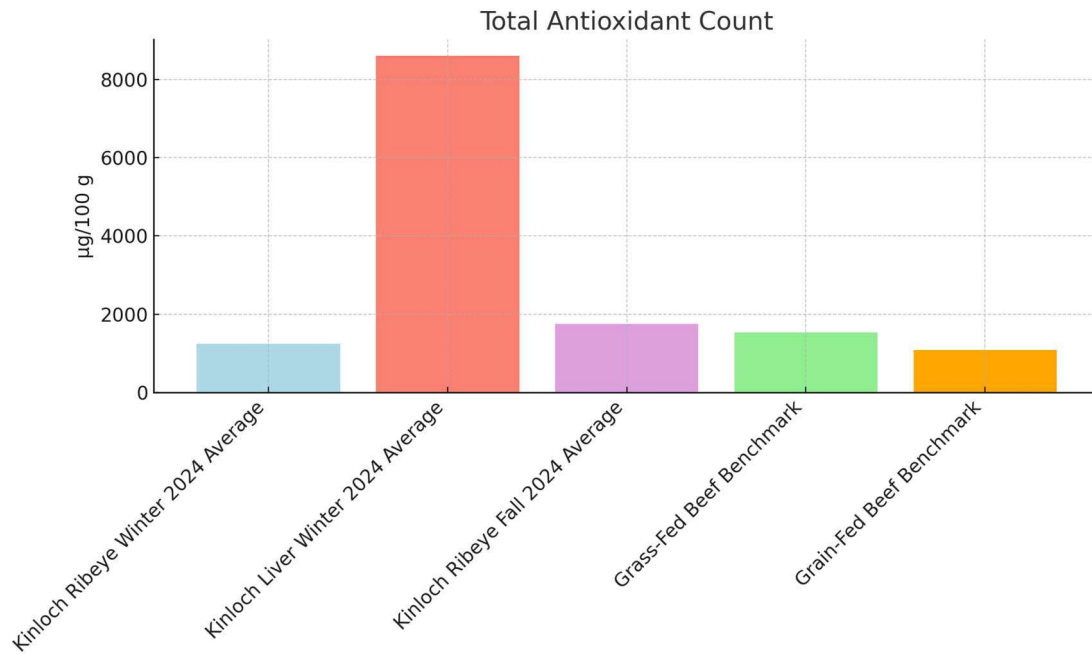
trans-Ferulic Acid



Trans-Ferulic acid is detected most in Liver, while Ribeye Winter contains none. Ribeye Fall is below both benchmarks.

Health Benefit: Possesses antioxidant and anti-inflammatory properties that help protect cells from oxidative stress.

Total Antioxidant Count



Liver has the highest total antioxidant count, far exceeding all other samples. All Kinloch samples show competitive or greater antioxidant capacity compared to grass- and grain-fed benchmarks; however, the Winter Ribeye was about 40% lower (depending on the phytochemical) compared to the Fall Ribeye, due to the presence of less phytochemicals in conserved vs fresh forages.

Health Benefit: Reflects the overall capacity of the food to neutralize free radicals and support oxidative balance in the body.

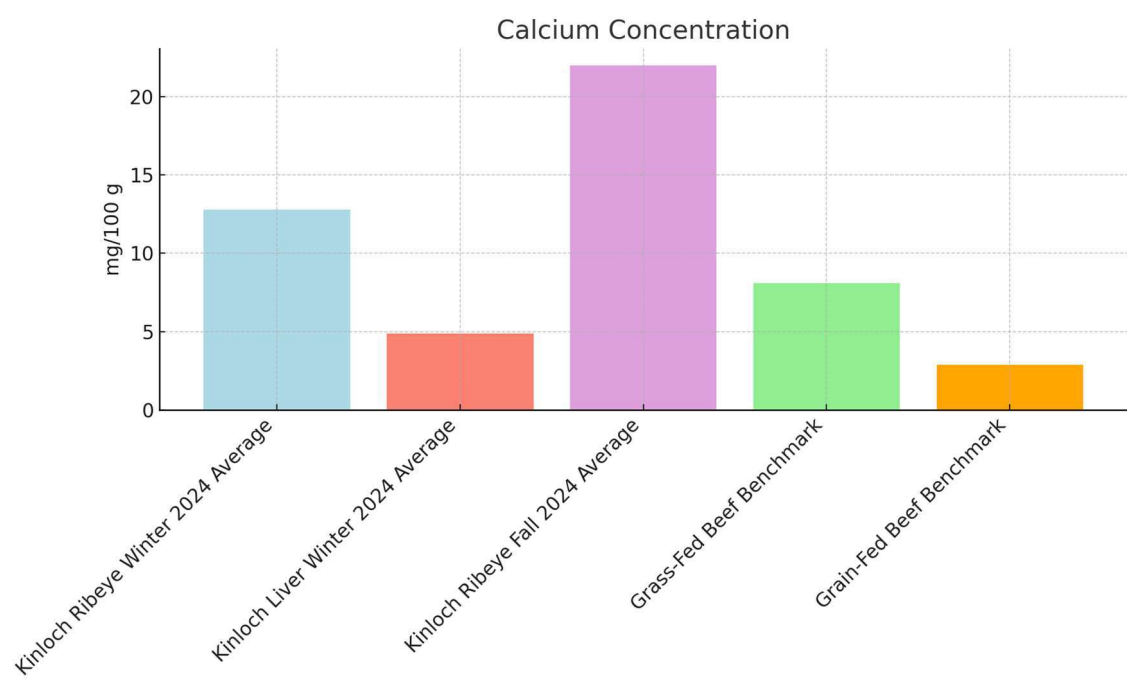
Mineral Concentrations



Introduction

In this section we analyzed the mineral content of Kinloch Ribeye and Liver across different times periods in comparison to Grass-fed and Grain-fed Beef benchmarks. Key minerals—calcium, iron, magnesium, and zinc—were measured.

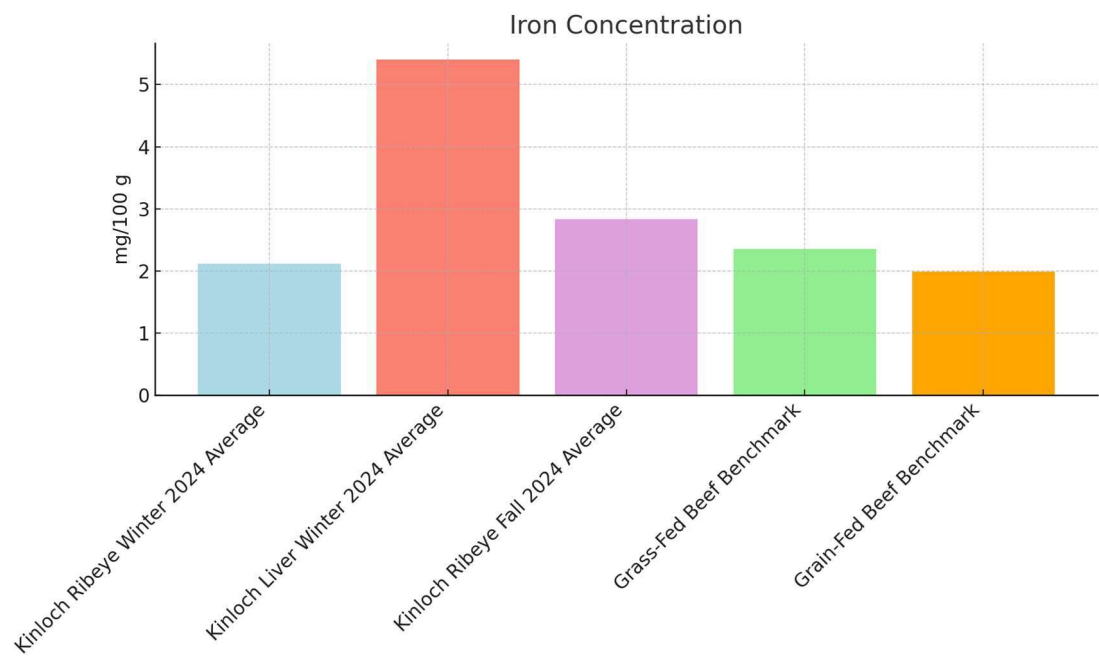
Calcium



Ribeye Fall shows the highest calcium concentration among all samples, followed by Ribeye Winter. Kinloch ribeye samples have higher calcium than both grass-fed and grain-fed benchmarks, while the liver has lower levels.

Health Benefit: Calcium is important for bone strength and muscle function.

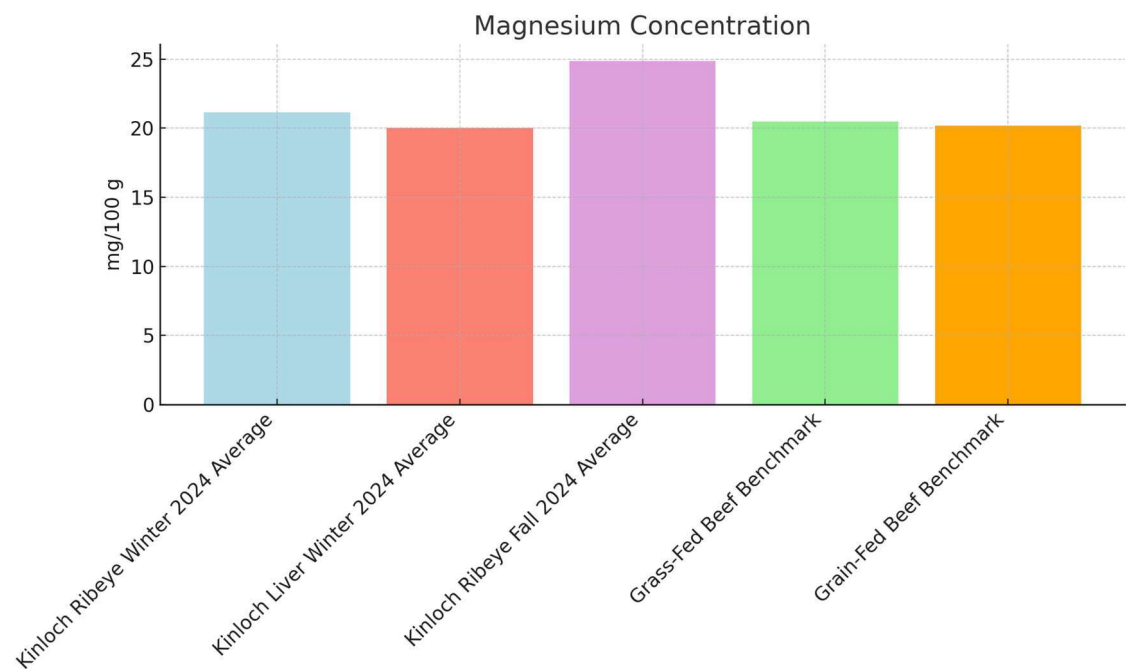
Iron



Liver contains substantially more iron than either Ribeye sample, aligning with its known role as a primary iron-rich organ. All Kinloch samples exceed or match the grass-fed benchmark iron levels, with Ribeye Winter slightly lower than Fall.

Health Benefit: Iron supports red blood cell formation and oxygen transport.

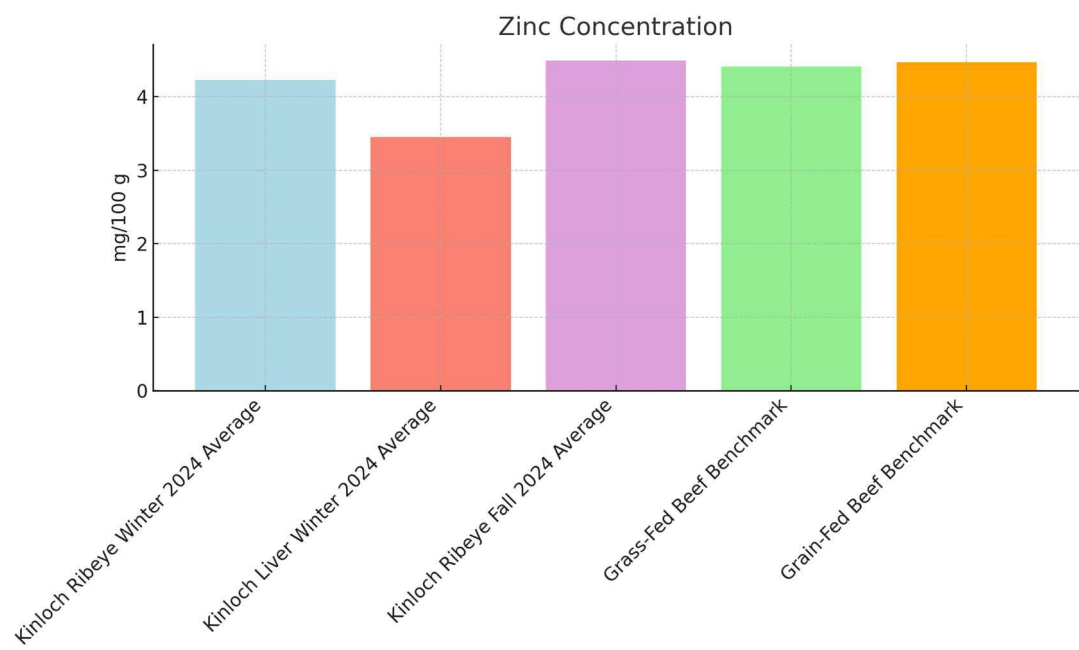
Magnesium



Magnesium concentrations are relatively consistent across all samples, with Kinloch Ribeye Fall showing a modest increase. All Kinloch samples are comparable to or slightly higher than both grass-fed and grain-fed benchmarks.

Health Benefit: Magnesium plays a role in nerve function, energy production, and muscle health.

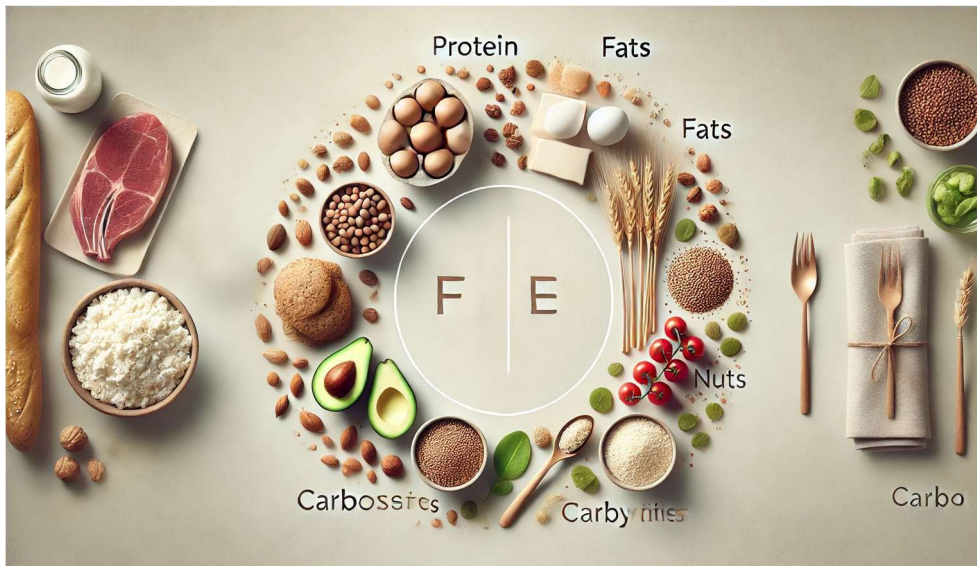
Zinc



Zinc levels are similar among all samples, with only minor variation. Kinloch Ribeye Fall has a slightly higher concentration than Kinloch Ribeye Winter.

Health Benefit: Zinc boosts immune function and supports wound healing.

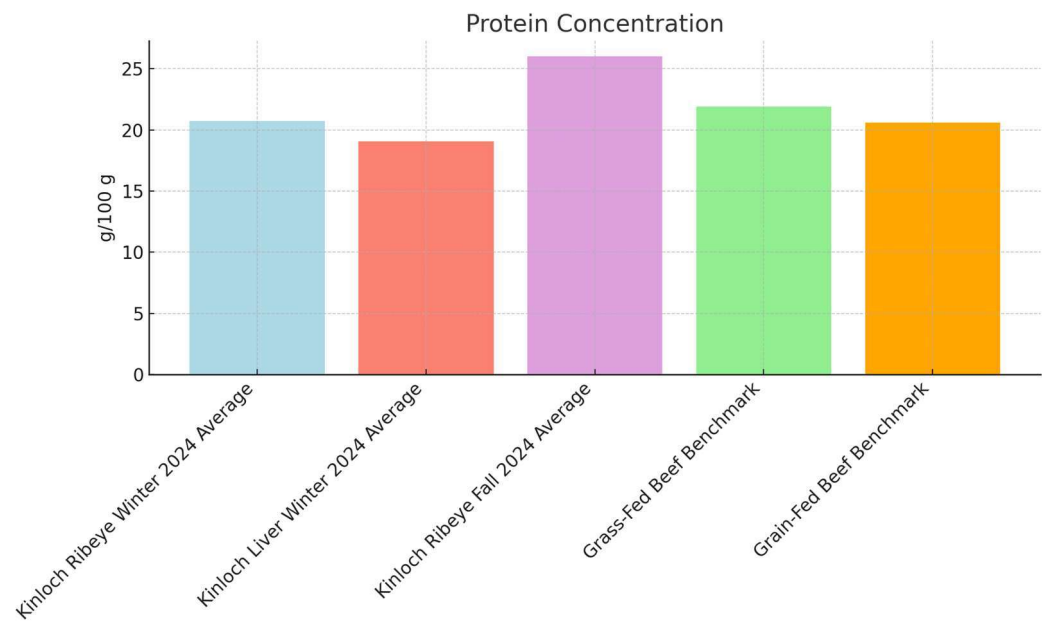
Macronutrient Concentrations



Introduction

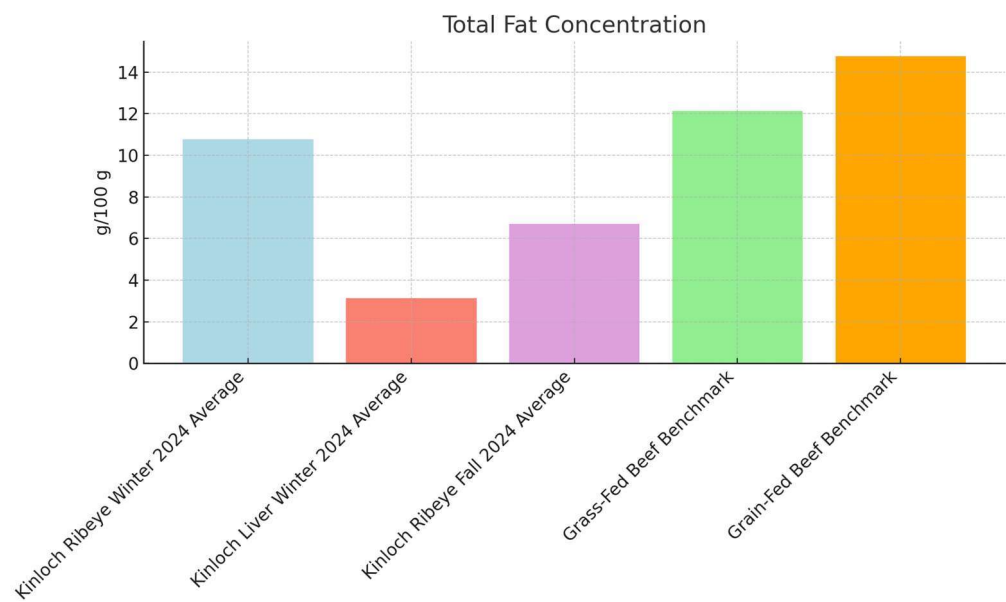
This section compares the macronutrient composition—protein and fat—of Kinloch Ribeye and Liver across different times periods to Grass-fed and Grain-fed beef benchmarks.

Protein



Ribeye Fall exhibits the highest protein concentration among the Kinloch samples, surpassing both Ribeye Winter and Liver. Compared to benchmarks, all Kinloch samples demonstrate competitive or higher protein content, particularly the fall sample.

Total Fat



Fat content is highest in Ribeye Winter and lowest in Liver. Kinloch Ribeye Fall and Winter are leaner than both grass-fed and grain-fed benchmarks.