Muscle profiling to add value to beef chuck, thin flank and topside

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EXECUTIVE SUMMARY

Introduction

In South Africa, the steak yielding cuts such as the loin and rump sell for considerably more per kilogram than the 'cheaper cuts' such as the topside. It has been shown that that consumer concerns regarding the affordability of beef decreases as income levels increase. High-income groups purchase and consume more steaks compared to the middle-income group. This would be due to the affordability of steaks. With current economic times it might be beneficial to offer the consumer a choice of steak that is perhaps not as expensive as the traditional steaks but also more of a luxury product than the original primal cuts which need to be slow cooked in order to achieve palatability traits which are satisfactory. Both income groups have been shown to purchase less beef roasts compared to beef mince probably due to convenience of cooking. A traditional pot-roast cut, which requires low temperature and slow cooking time, is not necessarily suited to the consumer's busy lifestyle of today. Retailers therefore have to offer a greater diversity of food options. It is therefore imperative to identify more affordable and sustainable manners in which to utilize the beef carcass for the growing South African population.

Eleven individual muscles were identified from the beef carcass as having the potential to become "new steaks" providing a new, more convenient product to the consumer and increasing the value of the beef carcass. The following muscles were collected: Adductor (Add), Gracilis (Gr), Infraspinatus (IS), Rectus abdominis (RA), Rhomboideus (Rhom), Rump

Cap (RumpC), Semispinalis (SS), Spinalis (Spinalis), Supraspinatus (SS), Serratus Ventralis (SV) and the Loin (L) which was used as a reference muscle. A total of 220 muscles were dissected form 20 beef steers which had been fed a commercial grain-based diet and received no beta-adrenergic agonist. Shear force tenderness, sensory evaluation, MFL, colour of meat, purge, and cooking losses were evaluated.

Objective Statements

From an economic point of view a large portion of the beef carcass is being underutilized. South Africans show a preference for steaks and if the cheaper primal cuts were separated into their individual muscles, it might be possible to sell good quality steaks from this. Not only would this increase the overall value of the carcass but it would also offer the consumer a more 'luxury cut' at a cheaper price than the traditional steaks which would be beneficial in tough economic times.

Project Aims

To investigate the utilization of individual muscle of the beef carcass as high quality dry-cooked cuts.

To investigate the quality properties of these cuts (Sensory, Warner Bratzler shear force, MFL, purge and colour shelf life).

Results

Tenderness: Warner Bratzler Shear Force (WBSF) is tenderness measured by mechanical method. Higher WBSF values indicate tougher meat and lower values more tender meat. All muscles had WBSF values which would be acceptable to consumers. Standard benchmarks for beef of 4.9 kg have been shown to result in 100, 99, 94, 86, and 25% customer satisfaction for tenderness, respectively. All muscles were below the 4.3kg threshold and all muscles but the Rhom 3D and Add 3D fell below the 4.0 kg threshold meaning that all the other muscles would result in 94% consumer satisfaction. Fourteen-day samples were more tender than the three-day samples but muscle seemed to have a greater effect with the IS, Spinalis, RumpC and SV having values below 3.0kg for both aging categories. The L, although having acceptable levels for both aging periods, was tougher than all of these muscles. Sensory tenderness agreed to a large extent with the results for WBSF in that the same group of muscles namely the Spinalis, IS and RumpC were rated as the most tender at both three and 14 days. Both the RA and L also appeared in the more tender side of the scale. Aging had no effect on tenderness with muscle being the main determining factor. Even though sensory tenderness highlighted the same muscles as being more tender, overall, none of the muscles performed as well as in WBSF evaluation.

Aroma and Flavour: The results were surprising with only the Spinalis scoring a higher frequency for grilled aroma and grilled flavour over both aging periods. For most muscles there was an increase in the frequency of grilled aroma score from three days to 14 days. This was most noticeable in the RA and RumpC, which at 14 days actually had a higher frequency of grilled scores than boiled compared to three days aging. The Rhom and the SV however had an increase in the number of samples scored as having a boiled aroma from day three to day 14 of aging. Other muscles such as the IS and the L had similar frequencies at day 3 and day 14 but again for both these samples there was a higher frequency of samples having a boiled aroma which is not expected for these two muscles. As suspected would be the case the Add had the highest frequency for boiled aroma and flavour except for the RA at three

days. Flavour did not follow exactly the same pattern as aroma. The Add, Rhom and SemiS had high frequencies of scores for boiled flavour and these frequencies also increased from day three to day 14, meaning at day 14 even fewer samples were scored as having a grilled flavour. Once again, the RA and RumpC had an increased in grilled flavour from day 3 to day 14 but this was not as obvious as in aroma. It must be stated however that both boiled and grilled categories for both aroma and flavour were scored very low in intensity meaning that all aromas and flavours were in fact bland.

Additional textures: The textures rubbery, spongy, gelatine and grainy were largely undetected in most muscles and where they were detected the score was low in intensity. Stringiness was largely detected in most muscles. Stringiness was however, reduced by aging. There were individual muscles which stood out especially when compared to the L. The Rhom, and to a lesser degree the SV and SemiS, stood out as being rubbery with sinew/connective tissue. The Spinalis performed as well or better than the L for all traits except for gelatin/slippery which was detected in most of its samples.

Additional flavours: Metallic and bloody flavour overtones were detected in most samples but the intensity scores were very low. The SS, SemiS, SV and Add had the highest occurrence of these flavours. Sourness was detected across all muscles with the Add having the highest occurrence. Warmed-over flavour was also detected in around half of the samples of all muscles. Caramel flavour which is positively associated with grilled meat was surprisingly largely undetected and intensity scores were low. The Spinalis had the highest frequency and intensity of caramel flavour.

Colour: Values for chroma higher than 20 relate to the bright red colour of bloomed meat and S=18, S=14 and S<12, as dull, distinctly brown and brown to gray-greenish brown. Chroma_A shows that all muscles except for the Gr 5D and RumpC 5D being above 20. This shows that the colour of all the muscles will be acceptable to the consumer who relies on visual appearance at the point of purchase and associates the bright cherry red colour of meat with freshness.

Purge: All muscles except for the Add had levels below the acceptable level of 2% purge. The Add had the highest percentage of purge at just below 4% with the L at 1.2%. All other muscles had levels below 1% with the Spinalis having only 0.2% purge. The high level of purge for the Add is undesirable as consumers are put off by excessive purge at the point of purchase.

Conclusion

While it would be beneficial to separate individual muscles from primal cuts if they could be sold as a premium product, this would make the process of deboning the carcass more labour intensive. It is therefore important that only muscles with the greatest potential are indentified.

The Add, Rhom, SemiS, SS and SV did not perform well over various (and in some cases all) quality traits. This was under dry cooking methods and it may be beneficial to investigate alternative cooking methods such us sous vide. The Spinals muscle however stood out above all others across all quality traits often performing better than the L. The IS and RumpC also performed well and it is recommended that these three muscles be utilized to their maximum potential. These muscles have already enjoyed success as new steaks in various other countries. The IS, marketed as the flat iron steak, has the connective tissue seam removed and currently sells 86 million pounds annually in the U.S. foodservice sector. It can now be seen that they would perform equally well in South Africa.

Popular Article

Title for Popular Article

Muscle Profiling in Beef

Introduction: The beef carcass is made up of over a hundred different muscles. These muscles have different properties which affect processing characteristics and consumer acceptability. USDA (2005) observed a trend that between 1993 and 1998 the wholesale value of beef ribs and loins had increased by just 3 – 5% but that there was a drop of 25-26% of the wholesale value of chucks, rounds and trimmings. This meant that from an economic point of view a large portion of the carcass's value was being unrealised.

In South Africa, the steak yielding cuts such as the loin and rump sell for considerably more per kilogram than the 'cheaper cuts' such as the topside. It has been shown that consumers concern regarding the affordability of beef decreases as income levels increase. High-income groups purchase and consume more steaks compared to the middle-income group. This would be due to the affordability of steaks. With current economic times it might be beneficial to offer the consumer a choice of steak that is perhaps not as expensive as the traditional steaks but also more of a luxury product than the original primal cuts which need to be slow cooked in order to achieve palatability traits which are satisfactory. Both income groups have been shown to purchase less beef roasts compared to beef mince probably due to convenience (including time) of cooking. Consumers of today want convenient, small portion sizes and healthy protein options when it comes to beef choices. A traditional pot-roast cut, which requires low temperature and slow cooking time, is not necessarily suited to the consumer's busy lifestyle of today. The beef industry's top marketed cuts to consumers are the middle cuts of the beef, known as the rib and loin. The reason for this is because these cuts meet the consumer's requirements for a juicy, tender, and flavourful cut of meat which is also quick to prepare. It is therefore imperative to identify more affordable and sustainable manners in which to utilize the beef carcass for the growing South African population.

Eleven individual muscles were identified from the beef carcass as having the potential to become "new steaks" providing a new, more convenient product to the consumer and increasing the value of the beef carcass. The following muscles were collected: Adductor (Add), Gracilis (Gr), Infraspinatus (IS), Rectus abdominis (RA), Rhomboideus (Rhom), Rump Cap (RumpC), Semispinalis (SS), Spinalis (Spinalis), Supraspinatus (SS), Serratus Ventralis (SV), Loin (L) which was used as a reference muscle. A total of 220 muscles were dissected form 20 beef steers which had been fed a commercial grain-based diet and received no beta-adrenergic agonist. Shear force tenderness, sensory evaluation, MFL, colour of meat, purge, and cooking losses were evaluated.

Results

Tenderness: Warner Bratzler Shear Force (WBSF) is tenderness measured by mechanical method. Higher WBSF values indicate tougher meat and lower values more tender meat. All muscles had WBSF values which would be acceptable to consumers according to Miller et al. (2001) who suggested that WBS tenderness values for beef of 4.9 kg would result in 100, 99, 94, 86, and 25% customer satisfaction for tenderness, respectively. All muscles were below the 4.3kg threshold and all muscles but the Rhom 3D and Add 3D fell below the 4.0 kg threshold meaning that all the other muscles would result in 94% consumer satisfaction. Shackelford et al. (1991) also reported threshold values of 4.6 kg and 3.9 kg for "retail" and

"food service" beef, respectively. Once again, all muscles had values below the threshold for retail and all but the Rhom 3D and Add 3D would be acceptable for food service. Fourteen-day samples were more tender than the three-day samples but muscle seemed to have a greater effect with the IS, Spinalis, RumpC and SV having values below 3.0kg for both aging categories. The L, although having acceptable levels for both aging periods, was tougher than all of these muscles. Sensory tenderness agreed to a large extent with the results for WBSF in that the same group of muscles namely the Spinalis, IS and RumpC were rated as the most tender at both three and 14 days. Both the RA and L also appeared in the more tender side of the scale. Aging had no effect on tenderness with muscle being the main determining factor. Even though sensory tenderness highlighted the same muscles as being more tender, overall, none of the muscles performed as well as in WBSF evaluation.

Aroma and Flavour: When the panel gave their first impression of aroma and flavour, they were asked to distinguish whether it came across as boiled or grilled. Although all samples were oven broiled and should have had a grilled aroma and flavour, we decided to include boiled as some of the muscles, such as the Add and SV, had a lot of drip when aging as well as cooking loss and did not seem to grill as well during pilot trials. As aroma and flavour are an integral part of consuming a steak, we thought it important to investigate whether any boiled meat aroma or flavour tones came through. The results were surprising with only the Spinalis scoring a higher frequency for grilled aroma and grilled flavour over both aging periods. For most muscles there was an increase in the frequency of grilled aroma score from three days to 14 days. This was most noticeable in the RA and RumpC, which at 14 days actually had a higher frequency of grilled scores than boiled, which was not the case at three days aging. The Rhom and the SV however had an increase in the number of samples scored as having a boiled aroma from day three to day 14 of aging. Other muscles such as the IS and the L had similar frequencies at day 3 and day 14 but again for both these samples there was a higher frequency of samples having a boiled aroma which is not expected for these two muscles. As suspected would be the case the Add had the highest frequency for boiled aroma and flavour except for the RA at three days. Flavour did not follow exactly the same pattern as aroma. For flavour the Add, Rhom and SemiS had high frequencies of scores for boiled flavour and these frequencies also increased from day three to day 14, meaning at day 14 even fewer samples were scored as having a grilled flavour. Once again, the RA and RumpC had an increased in grilled flavour from day 3 to day 14 but this was not as obvious as in aroma. It must be stated however that both boiled and grilled categories for both aroma and flavour were scored very low in intensity meaning that all aromas and flavours were in fact bland.

Additional textures: The textures rubbery, spongy, gelatine and grainy were largely undetected in most muscles and where they were detected the score was low in intensity. Stringiness was largely detected in most muscles. Stringiness was however, reduced by aging. There were individual muscles which stood out especially when compared to the L. The Rhom, and to a lesser degree the SV and SemiS, stood out as being rubbery with sinew/connective tissue. These muscles therefore from a texture point of view could probably be regarded us undesirable. The Spinalis performed as well or better than the L for all traits except for gelatin/slippery which was detected in most of its samples.

Additional flavours: Metallic and bloody flavour overtones were detected in most samples but the intensity scores were very low. The SS, SemiS, SV and Add had the highest occurrence of these flavours. Sourness was detected across all muscles probably due to the fact that they were all vacuum-packed during aging and storage. The Add had the highest occurrence of

sourness. Warmed-over flavour was also detected in around half of the samples of all muscles. Both the L and Rhom had a notable increase in the flavour with aging from 3 to 14 days. Caramel flavour which is positively associated with grilled meat was surprisingly largely undetected and intensity scores were low. The Spinalis had the highest frequency and intensity of caramel flavour.

Colour: Values for chroma higher than 20 relate to the bright red colour of bloomed meat and S=18, S=14 and S<12, as dull, distinctly brown and brown to gray-greenish brown. Chroma_A shows that all muscles except for the Gr 5D and RumpC 5D being above 20. This shows that the colour of all the muscles will be acceptable to the consumer who relies on visual appearance at the point of purchase and associates the bright cherry red colour of meat with freshness.

Purge: All muscles except for the Add had levels below the acceptable level of 2% purge. The Add had the highest percentage of purge at just below 4% with the L at 1.2%. All other muscles had levels below 1% with the Spinalis having only 0.2% purge. The high level of purge for the Add is undesirable as consumers are put off by excessive purge at the point of purchase. High purge would also have contributed to the Add having the highest values for lightness.

Recommendations: While it would be beneficial to separate individual muscles from primal cuts if they could be sold as a premium product, this would make the process of deboning the carcass more labour intensive. It is therefore important that only muscles with the greatest potential are indentified. The Add, Rhom, SemiS, SS and SV did not perform well over various (and in some cases all) quality traits. The Spinals muscle however stood out above all others across all quality traits often performing better than the L. The IS and RumpC also performed well and it is recommended that these three muscles be utilized to their maximum potential.

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