Welsh Lamb Meat Quality Project Trial 2

Lamb finishing diet and meat ageing period

RHAGLEN DATBLYGU CIG COCH
RED MEAT DEVELOPMENT PROGRAMME

HYBU CIG CYMRU
MEAT PROMOTION WALES

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Contents

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The programme encompassed three strategic projects: Stoc+, an animal health planning project, Hill Ram Scheme, a genetic improvement project and Welsh Lamb Meat Quality project, an eating quality project.

Foreword

Protected Geographical Indication (PGI) Welsh Lamb is a premium food product, with a worldwide reputation for quality and taste.

To ensure the sector is as resilient, sustainable and profitable as possible in an increasingly competitive global marketplace, HCC has established the Welsh Lamb Meat Quality project as part of its Red Meat Development Programme.

A comprehensive five-year study into the sector, the Welsh Lamb Meat Quality project draws on best practice to build a blueprint of taste consistency - enabling farmers and processors in Wales to meet the demands of a changing market.

This booklet provides the meat quality results from the Welsh Lamb Meat Quality project's second trial which completed in early 2022.

The trial was designed to investigate the effect of on-farm and processing factors on the eating and nutritional quality of lamb. The trial drew together 480 consumers, at three locations across the UK, who assessed the meat eating quality of Welsh Lamb.

Included here is an analysis of the consumer taste panel meat eating quality results, as well as demographic influences and participants' lamb purchasing habits.

Also explored is the importance of the nutritional quality of lamb products.

Summary

The Welsh Lamb Meat Quality project aims to investigate the impact of on-farm and processing factors on the meat eating quality of PGI Welsh Lamb.

This document outlines the results from the second of four meat quality trials. The second trial investigated the potential impact of lamb finishing diet and carcase ageing. PGI Welsh Lambs were sourced from a wide range of farms across Wales. Two meat cuts, the loin and the topside were used for the analysis.

Consumer taste panels took place during 2021 in Ludlow, Chester and Reading, with panel members drawn from the surrounding area. The consumers tasted and rated seven pieces of lamb, basing their eating quality scores on the attributes of aroma, tenderness, juiciness, liking of flavour, and an overall liking on a 0-100 line scale.

Consumer taste panel

Eating quality of Welsh Lamb was rated highly by the panellists with more than 80% grading lamb as "Everyday Quality", "Better than Everyday Quality" or "Premium Quality".

Eating quality was affected by muscle (cut), showing loin was preferred by panellists over topside for all attributes. As ageing time increased it showed a consistent and significant increase in all consumer score traits.

Satisfaction scores confirmed that ageing for 14 days improves the lamb palatability. 52% of consumers scored "better than everyday quality" or "premium quality", vs 46% for 7 days aged samples. This figure increased to 56% for 21 days aged samples, but this was a relatively smaller increase, suggesting that 14 days ageing would be the preferred choice for increased quality.

Finishing diet did not have an effect on eating quality of lamb, despite the variety of diets investigated in this trial.

There were no significant effects of carcase grade or fat class on eating quality.

Consumer taste panel demographic

The number of panellists eating lamb regularly were high with more than 50% consuming chops or cutlets on a weekly or monthly basis.

Older age groups ate lamb more frequently than younger panellists. They were also more likely to consider lamb expensive, nutritious, easy to prepare and tender. All age groups regard past experience as important when choosing lamb and this increased with consumer age.

Consumer gender had few effects on attitude and behaviour upon eating lamb. Occupation and income also had little effect.

Age group and the number of adults living in the household had a consistent and significant effect on the price panellists were willing to pay for lamb. Younger adults and households with three or more adults were willing to pay higher prices for premium quality lamb.

Nutritional quality of lamb meat

Of the treatments, muscle cut had the biggest effect on fatty acid concentrations, reflecting in the higher concentrations of intramuscular fat in the loin compared to the topside. Loin had higher levels of saturated fatty acids and monounsaturated fatty acids but a lower concentration of polyunsaturated fatty acids.

There was no effect of lamb finishing diet on the major groups of fatty acid concentration of the lamb meat.

Roots/brassicas and grass diets had higher concentrations of omega-3 fatty acids in the lamb meat compared to the concentrate containing diets. This would therefore suggest that a roots/brassicas diet may provide an alternative to a grass diet to increase the omega-3 content of lamb meat. However, the nature of the omega-3 fatty acids did differ between these two diets.

No effect on fatty acids or the major fatty acid groups was found with the three ageing periods. This is likely due to little oxidation occurring due to the ageing being carried out in vacuum packaging.

Mineral content varied by muscle cut with higher concentrations of both iron and zinc in the topside compared to the loin. Diet had no effect on zinc content but a muscle cut by diet interaction was observed for iron, where differences due to diet were observed for topside but not loin. No difference was found between the three ageing periods for zinc, however, iron content decreased with the length of ageing period.

Background

To qualify as PGI Welsh Lamb animals must be born and reared in Wales and slaughtered at approved abattoirs.

Lambs were sourced for this trial from farms across Wales where different farming systems suited to their location and environment are employed.

Several influences can create variation in eating quality including on-farm and processing factors. Among them are elements such as finishing diet, lamb gender, management systems, ageing of meat, differing meat cuts and hanging methods.

Consumer panels are an essential tool to assess meat quality and provide insight into public opinion and eating experience. The Agri Food and Biosciences Institute (AFBI) arranged the methodology for the consumer taste panels.

Method

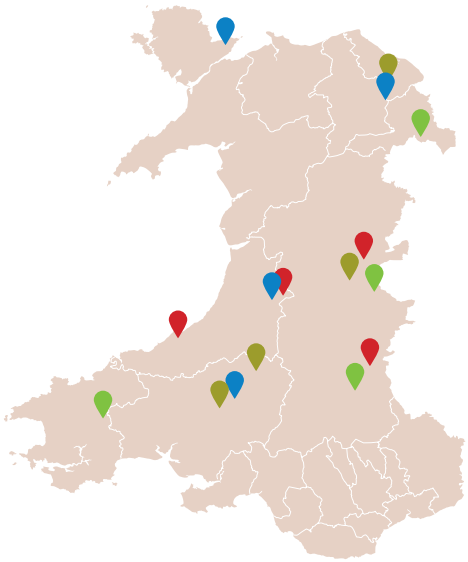
Sourcing of lambs

The Welsh abattoirs taking part in the second trial sourced a total of 144 lambs from farms across Wales (Figure 1). There were 3 slaughter dates and these took place from October to November 2020. Additional measurements were taken on farm over the final 6-week finishing period. These included grass/forage/concentrate samples and bi-weekly live weight measures of the lambs.

Farm locations for Trial 2

Key

- Root/Brassica
- Grass
- Indoor
- Grass & Concentrates



Finishing diets utilised during the trial were:

- grass,
- grass and concentrates,
- roots/brassica and
- indoor concentrate

The lambs were selected to be slaughtered at a target specification:

- Carcase cold weight – 16-22kg
- Conformation class - E, U, R
- Fat class – 2-3L

Additional lambs were selected out of specification due to experimental constraints, these included one lamb which had a fat class of '1' and six had a fat class of '4L'. Six lambs had a conformation grade of 'O'. In total 23 lambs were heavier than 22kg.

Only ram lambs were used in this trial. Two muscle cuts, the loin and the topside were sampled from both sides of each lamb and assessed.

Sample Preparation

The muscle cuts were sent to the Food Branch at the Agri-Food and Biosciences Institute (AFBI) where they were aged at 4°C. The samples were balanced and aged for 7 days, 14 days and 21 days.

Loin and topside cuts from each side were prepared for sensory and nutritional analysis. The sensory analysis used the same globally recognised standard techniques developed by Meat Standards Australia (MSA). The samples were cut into 15mm thick similar-sized square pieces before being wrapped for grilling. They were 'balanced' so that each cut would be sampled by different panellists, in other locations and on different dates. Also, the position of the samples on the grill varied.

Consumer Taste Panels

The consumer taste panels for Trial 2 took place in August, September and December 2021 at three locations – Ludlow, Chester and Reading. The panels were conducted according to the MSA protocols; with each venue hosting 160 consumers in eight groups of 20.

The session began with a *demographic questionnaire* where the panellist was asked about their background, lifestyle and previous experience when buying lamb.

The second part of the questionnaire was an *eating quality assessment* of seven grilled samples of different cuts of meat. Consumers were asked to score them on a 0-100 line-scale based on:

- Liking of aroma
- Tenderness
- Juiciness
- Liking of flavour
- Overall liking

Consumers were also asked to rate the satisfaction quality of each sample based on a four-point scale:

1. Unsatisfactory
2. Satisfactory everyday quality
3. Better than everyday quality
4. Premium quality

Finally, consumers were asked about their 'willingness to pay' for each of the satisfaction grades.

Nutritional quality method

The remaining meat samples were used for nutritional quality analysis. The loin and topsides were studied for their total amount of intramuscular fat content and individual fatty acids and mineral content.

Protein and amino acid levels were evaluated for lamb chumps finished on two diets – grass only and indoor concentrate finished. The ageing period was assessed and meat was aged for 7 days, 14 days and 21 days. 72 lamb samples were used and these were sourced from 12 lambs from each of the grass and indoor concentrate fed diets and were also balanced for ageing period.

Analysis

The consumers' eating quality data and the accompanying demographic information was analysed and each taste panel questionnaire tabulated using specialist software. Additional quality assurance checks followed.

Statistics regarding the effects of muscle cut, breed type, gender and panel location were analysed, as was additional recorded information such as fat class and conformation grade obtained from the abattoirs (which were unbalanced).

Case study:

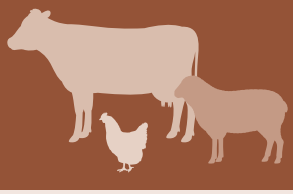
Godregarreg Farm

Efficient production of lambs off grass and concentrates

Aaron Hughes, Godregarreg Farm, Godregarreg, Llangadog, Carmarthenshire

Farm Facts: Godregarreg Farm

- 440 acres
- 500 sheep
- 120 dairy cows
- 32,000 laying hens



Introduction

Aaron Hughes alongside his parents and brother, farm 440 acres at Godregarreg Farm in Llangadog.

The farm is 200ft above sea level and keeps 500 breeding sheep, including Dorset and Cheviots. The ewes are crossed with a Beltex terminal sire with the aim to target a carcase weight of 20-21kg.

Alongside the sheep enterprise Godregarreg have 120 head of Fleckvieh dairy cows and also run a 32,000 layer egg enterprise.

Aaron rotationally grazes his flock and uses concentrates for target finishing of lambs. Aaron says *"We aim to get lambs off as efficiently as possible and in the winter months that can include supplementing with concentrates when the quantity and quality of grass lessens".*

Finishing System

To achieve target specifications, managing livestock nutrition is crucial. Aaron states that *"producing nutritious grass is important for our sheep and cattle. We aim to finish our Dorset cross lambs within 16 weeks."*

In order to maximise the use of homegrown grass-based pastures, some sheep are rotationally grazed, the growing cattle are grazed on a neighbouring holding during the summer and the Fleckviehs are stripped grazed in the autumn until they are housed. This sustainable practice allows them to further increase stocking numbers and carrying capacity.

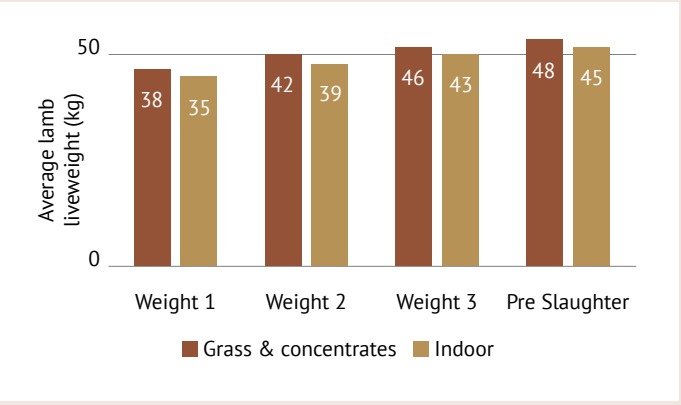
Figure 1. Lamb creep feed used at Godgregarreg. Image above: Aaron Hughes.

Welsh Lamb Meat Quality Project

In 2020, Godregarreg supplied lambs for the Welsh Lamb Meat Quality project, collecting liveweight data from 26 Welsh Mule lambs finished on either a diet of grass supplemented with concentrates or an indoor concentrate diet. At the start of the six week finishing period lambs weighed on average 35.7kg, with a weight range from 28kg to 42kg.

Following the initial weighing, lambs were then weighed every fourteen days. The third weight recording data showed that the lambs average weight had increased to 43.7kg. The pre slaughter lamb weight average was 45.4kg. On average lamb weight increased at 258g/day for both diets.

Figure 2. Average lamb liveweight of all lambs from September 8th to October 15th 2020.



Conclusion

Godregarreg Farm uses an efficient lamb finishing system, by utilizing appropriate feed and prompt selection of lambs. Since the Welsh Lamb Meat Quality project Godregarreg have altered their system by breeding more terminal sired lambs. Lambs are also now weighed on a weekly basis during their finishing period.

Case study:

Wernoog Farm

Finished lambs off grass for Trial 2

Ernie Richards farms with Stuart Morris,
Wernoog Farm, Clyro, United Kingdom

Farm Facts: Wernoog Farm

- 350 acres
- 1000 Lleyn ewes

Introduction

Working as a shepherd, Ernie Richards farms with Stuart Morris at Wernoog Farm, Clyro overlooking Hay-on-Wye. The upland farm totals 350 acres and consists of 1,000 Lleyn ewes. Wernoog was one of four project farms that finished lambs off grass for Trial 2 of the Welsh Lamb Meat Quality project.

At Wernoog, lambs are predominately finished off grass. Between September 2020-October 2020 the farm collected liveweight data from 65 Lleyn ram lambs for the project. Fortnightly weighing lambs and assessing their condition helped Ernie and Stuart target a carcase weight between 16-22kg.

Finishing System

Lambs are finished off grass on a rotational grazing system with the land rising above 1000ft. Ernie commented *"our grass-based system here allows us to produce high quality Welsh Lamb whilst making the most of the land and natural resources that we have".*

As part of the project weekly grass samples were analysed to understand how the nutritional content of the forage contributed to the efficiency of lamb finishing. Soil samples were also taken. These results will be used to understand how the nutritional composition of the finishing diet contributes to the nutritional density of the lamb meat. *"The results have enabled us to understand how to best utilise our grass. The soil report recommended applications of both phosphate and potash with no requirement for lime, we have taken these recommendations on board to improve grass growth, reducing the need for purchasing additional feed".*

Images – Below: Ernie Richards. Above: Stuart Morris.

Welsh Lamb Meat Quality Project

Pre slaughter Wernoog lambs averaged 47kg. Lambs were selected for the project based on the target carcase weights of 16-22kg. The Wernoog lambs selected for the project averaged 21.9kg dead weight, with a killing out percentage of 44%. The fat class specification for selection included carcases graded as a 2, 3L or 3H, all of the 49 lambs Wernoog supplied to the slaughter date hit this specification. *"Targeting the desired fat class and weight specifications are important to the efficiency of our business, weighing regularly helped with selecting lambs suitable for the project".*

Conclusion

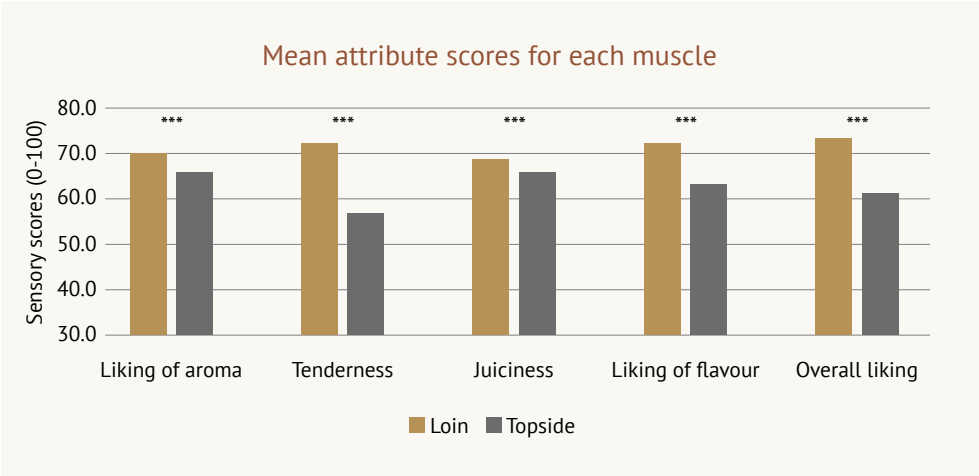
Efficiently finishing lambs and hitting market specifications are important to the sheep enterprise at Wernoog. *"We were very happy to have been involved in this project which is helping the industry understand how beneficial utilising forages are for farm efficiency and meat quality".* Ernie and Stuart have made several changes since supplying lambs including weighing lambs more regularly, gaining a better understanding of growth rates. Having lambs in smaller groups and moving them more frequently has also been a change which was instigated from the trial and has now proven successful in finishing lambs.

Results

Meat eating quality

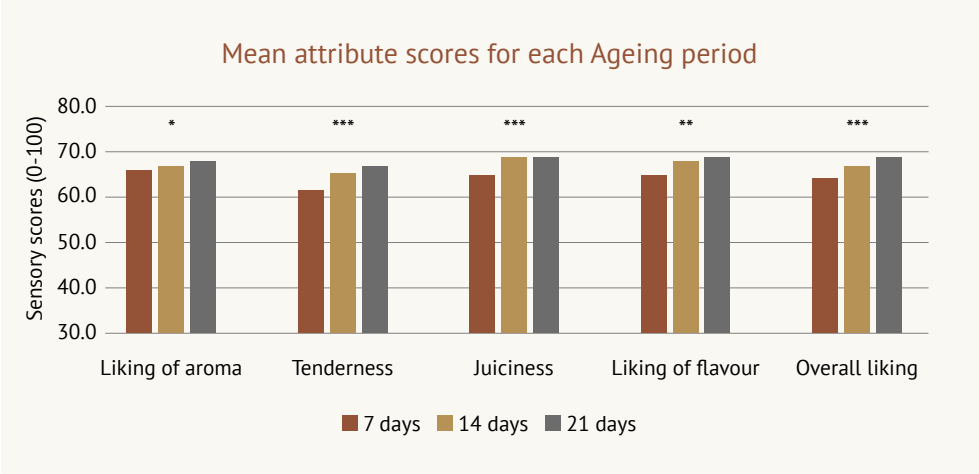
Consumers scored loin samples higher than topside samples across all meat eating quality traits (Figure 1). The majority of these loin samples scored favourably for all eating quality traits. The topside scores were within an acceptable mean score of 61 for overall liking, compared with 72 for loin (on a scale of 0-100).

Figure 1. Mean attribute score for each muscle cut.



The results suggest that consumers could taste some difference between 7, 14 and 21 day aged meat (Figure 2).

Figure 2. Mean attribute scores for each ageing period.



Finishing diet did not affect the eating quality of lamb, despite the variety of finishing diets investigated in this trial (Table 1).

Also, in this trial, carcase conformation or fat grades did not affect the eating quality significantly.

Table 1. Mean scores for different lamb diets.

Attribute	Average eating quality scores (0-100)				Probability	Significance
	Diet					
	Roots	Grass	Concentrate	Grass and Concentrates		
Liking of Aroma	67.9	68.2	66.0	67.5	0.108	ns
Tenderness	63.1	63.1	65.5	65.0	0.328	ns
Juiciness	67.4	67.0	67.2	67.7	0.957	ns
Liking of flavour	68.1	67.1	65.6	67.8	0.176	ns
Overall liking	67.0	6.4	65.2	67.4	0.356	ns

ns – not statistically/significantly different

Consumer satisfaction

Muscle cut effect on consumer satisfaction

Almost all (94%) consumers rated the loin samples as "satisfactory everyday quality" and above, with 62% rating it "better than everyday quality" or "premium quality" (Figure 3).

83% of panellists rated the topside samples at least "Satisfactory everyday quality", with 40% rating it "better than everyday quality" or "premium" (Figure 3).

Figure 3. Effect of muscle cut on percentage of consumers giving each satisfaction rating.

Ageing effect on consumer satisfaction

Ageing time positively affected consumers satisfaction score. Samples aged for 7 days were rated as "satisfactory everyday quality" and above by 87% of panellists, compared with 89% for 14 and 21 days aged samples.

The number of panellists who found the lamb to be either 'better than everyday quality' or 'premium' increased steadily with ageing time, from 46% (7d) to 52% (14d) to 56% (21d)(Figure 4).

Almost a quarter (24%) of consumers rated 21 days aged samples as premium, compared with 14 days aged (20%) and 7 days aged (16%, Figure 4).

Lamb diet and panel location did not affect satisfaction scores.

Figure 4. Effect of ageing time on percentage of consumers giving each satisfaction rating.

Carcase grade – There was no significant effect of carcase grade on eating quality (Table 2) which is consistent with the findings in Trial 1.

Fat class – No significant effect was found on fat class on eating quality, despite a slightly broader range of fat classes recorded in this trial when compared to Trial 1.

Demographic results

All consumers were asked a range of socioeconomic, attitude and behaviour questions. The results of these were very similar to those reported in Trial 1. Any differences will be described in this report.

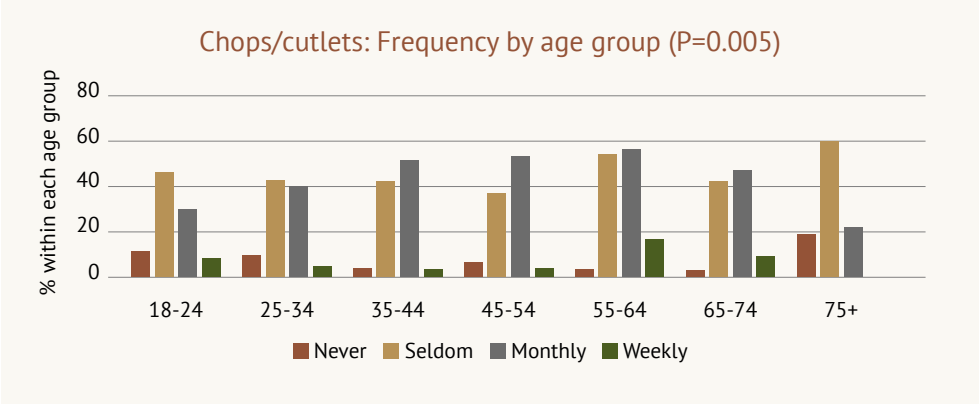
In Trial 2, there were significant differences in consumer demographics between locations, this included age, gender, occupation, household income, number of children in the household and number of adults in the household.

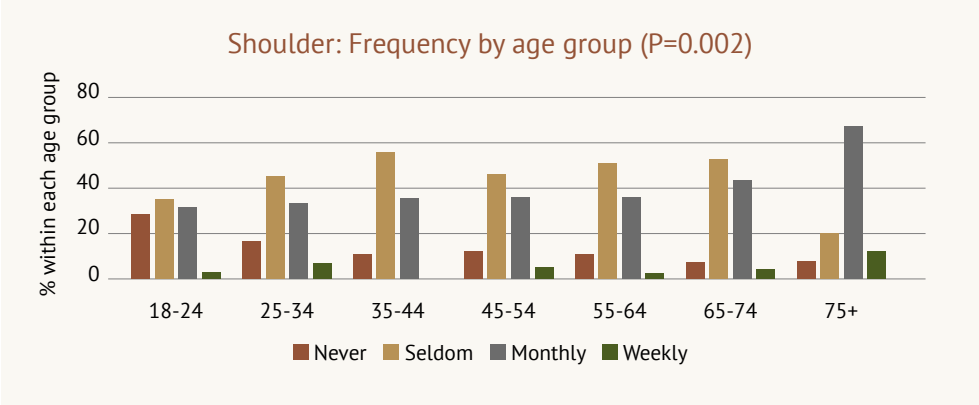
Age group

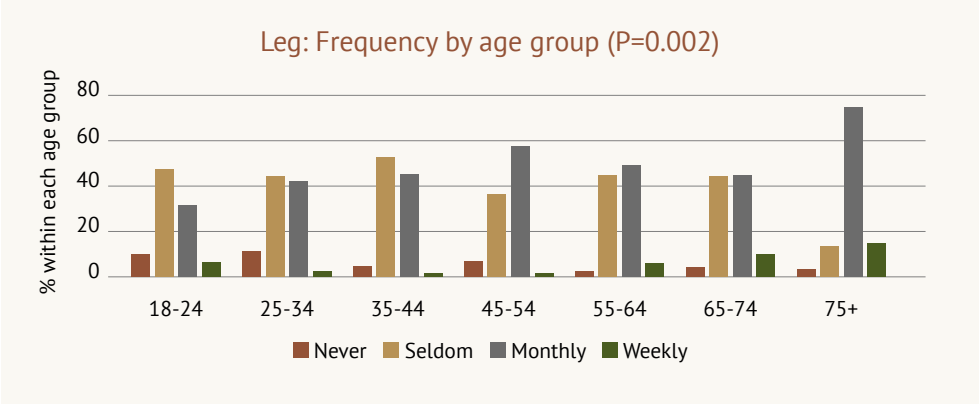
Older panellists were more likely to consume each of the lamb products (chops, shoulder, leg, roasting loin, cubed or minced). More than 50% of panellists aged under 24-year-olds seldom or never consumed these cuts.

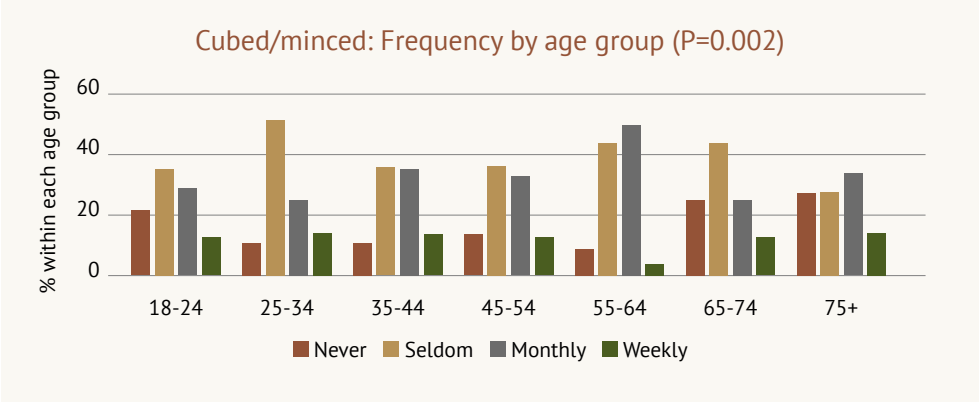
The numbers of panellists eating lamb regularly were higher amongst the Trial 2 consumers than in Trial 1, with more than 50% consuming chops or cutlets on a weekly or monthly basis.

Figure 5. Effect of age group on frequency of purchase of lamb cuts by different age groups.



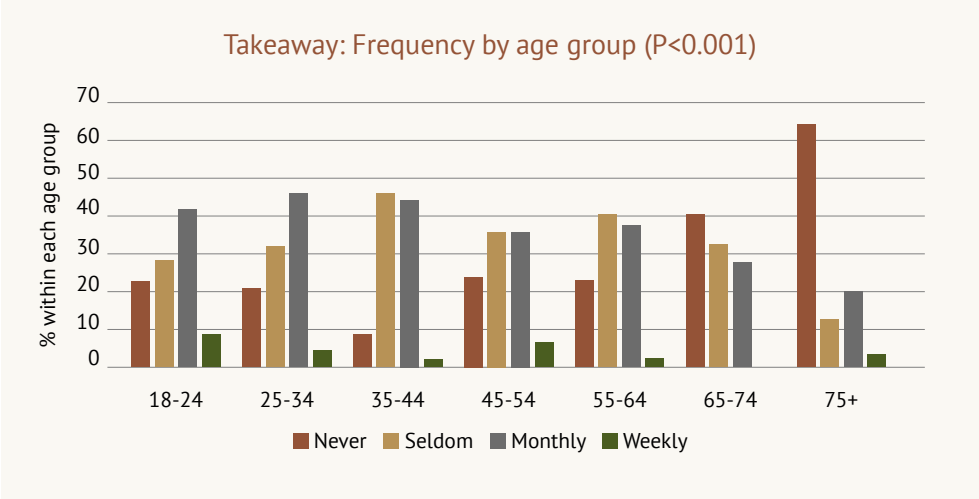






When asked about the consumption of takeaway meals, there was a difference found between age group (Figure 6). Takeaway meals were consumed more frequently by younger panellists and less frequently by those over 65.

Figure 6. Percentage within each age range who purchase take away meals.



Questions were asked related to *"In your experience, do you consider lamb to be..."* referring to a range of factors regarding lamb price, perception of healthiness, ease of preparation as well as the sensory qualities of tenderness, aroma and flavour.

Panellists from older age groups (especially those over 65) perceived lamb to be:

- Expensive
- Healthy
- Easy to prepare
- Tender

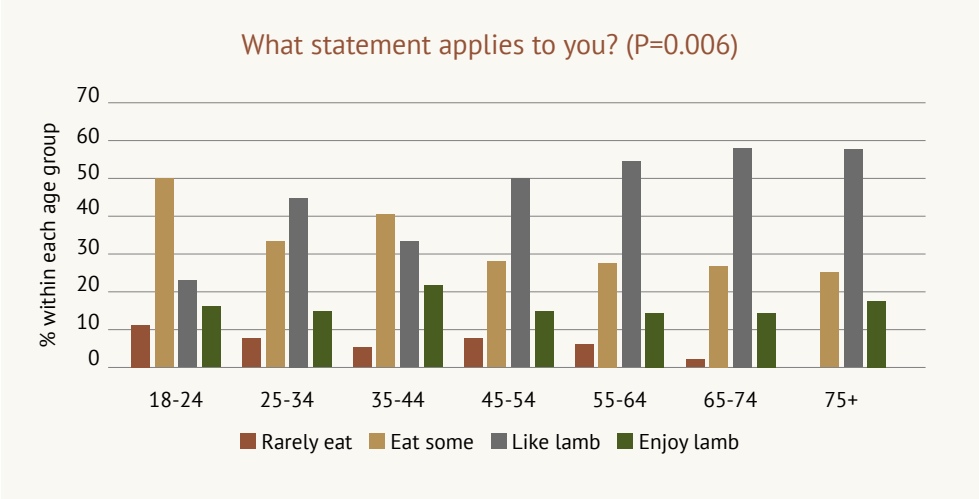
As in Trial 1, older consumers (55 years and older) placed more importance on parameters such as cooked aroma, tenderness, nutritional quality, animal welfare, knowledge of source and the environment when buying lamb. There is a clear trend for older consumers to place more importance on past experience (Figure 5), but even in the youngest age group, two thirds of consumers found past experience moderately or very important.

The panellists were asked to respond to one of four following statements.

1. I enjoy lamb, it is an important part of my diet
2. I like lamb, it is a regular part of my diet
3. I do eat some lamb
4. I rarely eat lamb

Age of consumer did impact on the results to these statements. The proportion of panellists responded with "I enjoy and I like lamb" ranged from 40% of the 18-24 age group, 50-60% for those between 25-44, 60-70% of those between 45 and 64 and over 70% of consumers over 65 (Figure 7).

Figure 7. Consumer statement about enjoyment of lamb.



Panellist gender

In contrast to the results from Trial 1, panellist gender had no significant effect on the enjoyment of lamb, or importance of value, aroma, tenderness, nutritional quality, past experience, animal welfare, environment when purchasing lamb. Like Trial 1 panellist gender did affect the importance of juiciness (P=0.006), ease of preparation (P=0.002) and knowledge of source (P=0.001), with more women finding these parameters moderately or very important.

Willingness to pay

Panellists were asked to state the price they would be willing to pay for the four satisfaction categories:

- Unsatisfactory
- Satisfactory everyday eating quality
- Juiciness
- Better than everyday eating quality
- Premium

Age group influenced the prices panellists were willing to pay, with the highest prices paid for premium quality meat by those under 34. Those under 34 and the over 65's were willing to pay the highest prices for satisfactory everyday quality.

Where there were two or more adults in the house, consumers said they would be willing to pay more for better than everyday and premium quality meat. Neither panellist gender, household income nor number of children in the household had any effect on the price consumers were willing to pay for any grade of lamb.

Nutritional Quality Results

Fatty acids

Muscle cut and fatty acids

It was observed that the topside cut had lower intramuscular fat content (2.0%) than the loin (2.4%). Topside had lower levels of saturated (SFA) and monounsaturated (MUFA) fat content (Figure 8). It is suggested that the muscles differed in fat content dependent on their biological role within the body. Topside had higher polyunsaturated fat (PUFA) including omega 3 and 6 fatty acids compared to the loin (Figure 9). This later finding is potentially worthy of further investigation.

Figure 8. Saturated (SFA) and Monounsaturated fat (MUFA) content of lamb loins and topsides from Trial 2.

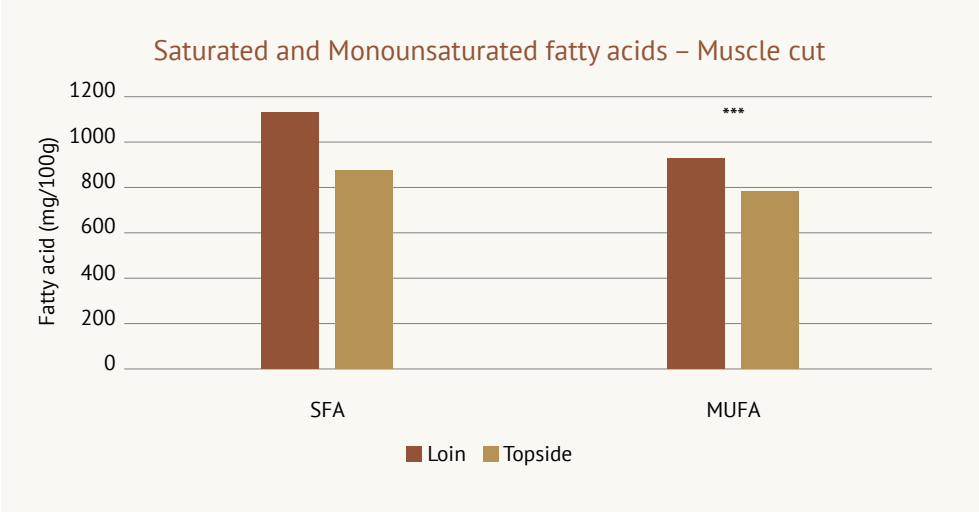
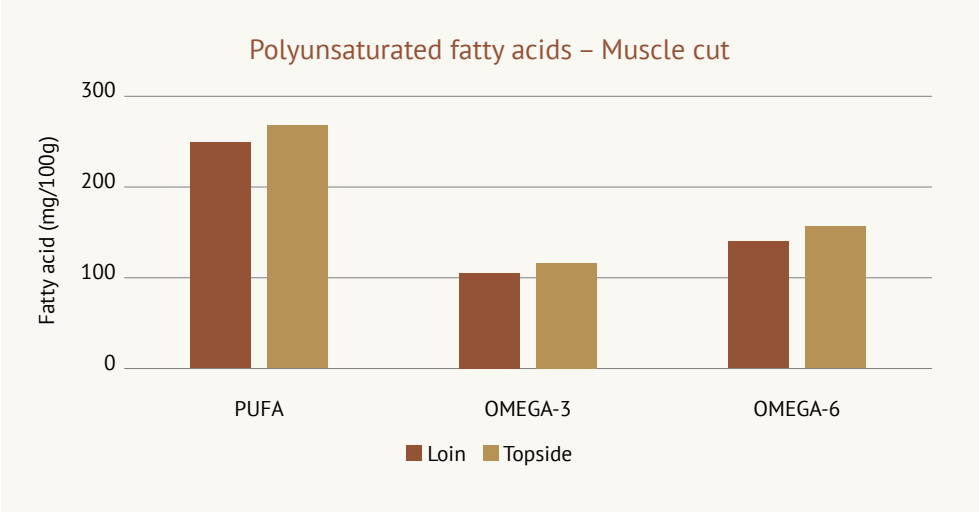


Figure 9. Polyunsaturated (PUFA), omega 3 and omega 6 content of lamb loins and topsides from Trial 2.



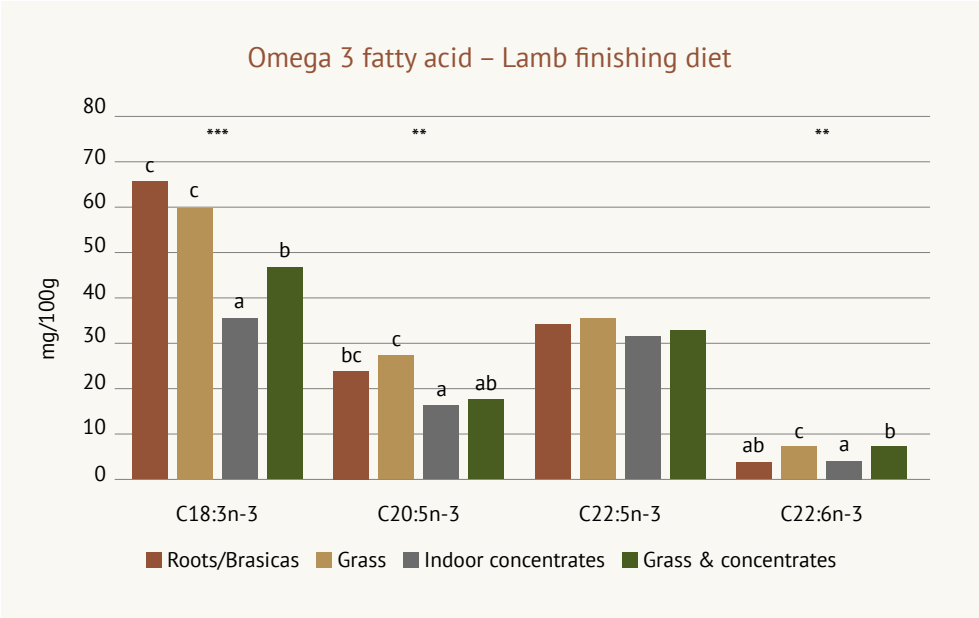
Lamb finishing diet and effect on fatty acids

With the four finishing diets tested:

- Grass
- Grass and concentrates
- Roots/brassica and
- Indoor concentrate

No difference was observed for intramuscular fat content or the grouped fatty acids – saturated, monounsaturated and polyunsaturated. However, roots/brassicas and grass diets had higher concentrations of omega-3 fatty acids compared to the concentrate containing diets (Figure 10). This would therefore suggest that a roots/brassicas diet may provide an alternative to a grass diet for increasing the omega-3 acids compared to the concentrate containing diets.

Figure 10. Omega 3 fatty acid concentration of lamb finishing diet.



Omega 3 and 6 fatty acids and their roles in the body

Omega-3 and omega-6 fats are essential fatty acids and can only be sourced from diets. Omega-3 fats are considered to be healthy. These are used in the human body for cell membrane structure and are good for nerves and brain function.

The difference in omega-3 content led to a difference in omega-6:omega-3 ratio. Ideally this should be between 2 and 1 with a lower figure indicating higher volume of healthier omega-3 fats. Other studies have found lamb can be between 4 and 1, however the lowest n-6/n-3 ratio within this trial was from grass-fed lamb at 0.94 and would be considered very healthy. The highest omega-6:omega-3 ratio was found with the concentrate fed lamb at 2.05 which is still considered to be healthy.

Ageing and the effect on fatty acids

There was no difference in fatty acids when lamb loins and topsides were aged/matured for 7, 14 and 21 days in a vacuum packed bag. When lamb is aged as a carcase it can affect the fatty acid concentration however in a vacuum packed sealed bag fatty acid composition is less effected as fats cannot oxidise.

Ageing did not effect the amino acid content of the lamb meat. Again, it is suggested that this is due to the effectiveness of packaging and the vacuum not allowing amino acids to degrade/alter within a 7, 14 or 21 day period.

Amino acids

Lamb finishing diet and the effect of amino acid content of lamb meat

Diet also effected the amino acid content of lamb meat – two diets within this trial were analysed – grass only and concentrate indoor fed lambs. It was found that lambs fed on both diets contained all the essential amino acids that are needed for healthy diet. It was also found that the grass fed lambs had significantly increased 5 essential amino acids Leucine, Lysine, Threonine, Tyrosine, Valine.

Amino acid functions in the body

Leucine: is an amino acid that is used by skeletal muscle to provide energy during exercise.

Lysine: plays a major role in protein synthesis, energy production and the production of collagen and elastin.

Threonine: helps keep connective tissues and muscles throughout the body strong and assist wound healing.

Tyrosine: assists memory function and relieves stress.

Valine: helps muscle growth and muscle energy production.

Ageing and the effect of amino acid content of lamb meat

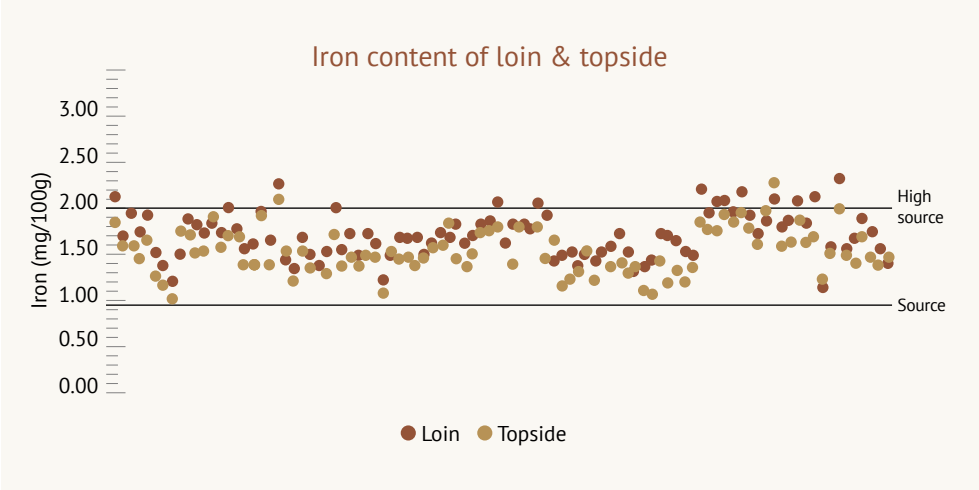
There was a significant difference in Leucine, Serine and Valine content within the lamb meat that had been aged for 7, 14 and 21 days. The longer the ageing period the higher the concentration of Leucine, Serine and Valine in the lamb meat.

Mineral

Muscle cut effect on mineral content of lamb meat

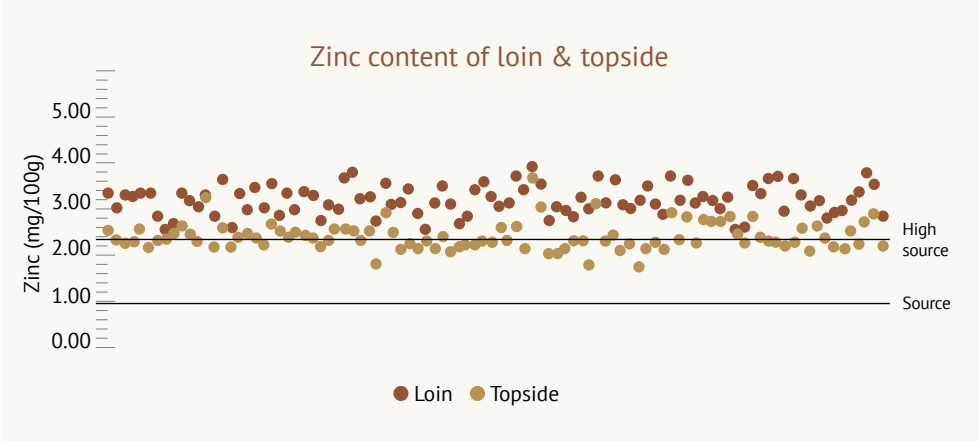
Iron and zinc content of the lamb meat was also analysed. Similar to Trial 1 topside had higher iron content than the loin (Figure 11). The loin had an average of 1.53mg/100g, the topside had an average of 1.71mg/100g. All muscle cuts could be considered a source of iron with 2% of loins and 13% of topsides considered a high in source of iron.

Figure 11. Iron content of lamb loins and topside from Trial 2 (levels considered to be high in and a source based on Australian standards NHMRC, 2006).



Topside had higher zinc content than the loin (Figure 12). The loins had an average zinc content of 2.32mg/100g and topsides had average of 3.14mg/100g. All topside lamb meat samples and 34% of loins were considered a high source of zinc. It is suggested that these differences are due to physiological muscle use and differences in muscle fibre type. Red muscle fibre types typically contain more zinc and iron compared to white muscle fibres.

Figure 12. Zinc content of lamb loins and topside from Trial 2 (levels considered to be high in and a source based on Australian standards NHMRC, 2006).

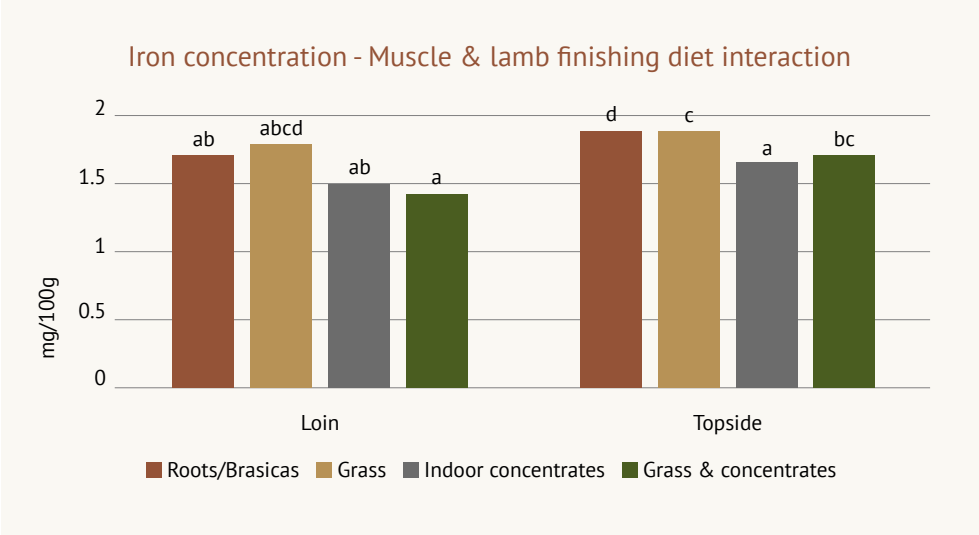


Lamb finishing diet and its effect on mineral content of lamb meat

Lamb finishing diet did not effect iron or zinc concentrations of lamb meat in this trial.

However, there was an interaction observed with diet and muscle (Figure 13). In the loin there was no significant difference in iron concentration with diet. In the topside the highest concentration was found in the roots/brassicas diet; the grass and grass & concentrates diet were similar to each other and the indoor concentrates diet was significantly lower than the other 3 diets.

Figure 13. Muscle and diet interaction on the concentration of iron.



Ageing and effect on mineral content of lamb meat

No significant difference was observed in zinc concentrations with ageing however there was a difference in iron. Iron content was significantly lower at 21 days compared to 7 days ($P<0.022$).

Conclusions

The second trial in the Welsh Lamb Meat Quality project has provided a range of data on consumer preferences with meat quality, nutritional quality and consumer behaviour when buying and eating lamb.

The main conclusions are:

- There were highly significant differences due to muscle (cut) with loin scored higher by consumers for all attributes.
- Ageing resulted in highly significant differences for Tenderness, Juiciness and Overall Liking, with a longer ageing time associated with higher scores. Most of the increase was achieved by 14 days ageing, with only a small increase up to 21 days ageing.
- Lamb finishing diet did not influence consumer preference.
- Older age group of panellists ate lamb more frequently than younger panellists. They were also more likely to consider lamb expensive, nutritious, easy to prepare and tender. Age group and the number of adults living in the household had consistent and significant effects on the price panellists were willing to pay. Younger adults and households with three or more adults were willing to pay higher prices for premium lamb.
- Muscle cut had the greatest effect on fatty acid composition of the lamb meat. This is due to the higher concentrations of saturated and monounsaturated fat in loin than topside.
- Diet did not effect the major fatty acid groups – intramuscular fat, saturated, monounsaturated and polyunsaturated fatty acids. Diet did effect Omega-3 fatty acids in the meat. Animals fed the roots/brassicas and grass diets were higher than the two diets containing concentrate.
- Ageing of lamb carried out in vacuum packaging for the three ageing periods 7, 14 or 21 days did not alter individual fatty acid content or their major groups.
- Grass finished lambs had higher concentrations of the amino acids including five essential amino acids - Leucine, Lysine, Threonine, Tyrosine and Valine compared to concentrate finished lambs.
- Muscle cut effected mineral content with higher concentrations of both iron and zinc in the topside compared to loin. The diets investigated had no effect on the zinc or iron content.
- There was no effect of ageing on zinc concentrations, however iron content decreased with the length of the ageing period.

Industry Implications

The eating quality of Welsh Lamb is very good with the majority of loin samples scoring favourably for all eating quality traits.

In this trial lamb finishing diet did not impact the eating quality of Welsh Lamb. Roots/brassicas and grass based diets positively impacted the nutritional quality of lamb meat in terms of omega-3 fatty acids and amino acids.

Ageing lamb for 14 days in vacuum pack rather than the conventional 7 days should, if feasible, be considered, as it has been shown to provide benefits in both eating quality for all attributes, as well as satisfaction scores. Ageing also increased some amino acids but decreased iron content.

Muscle cut effected sensory scores and nutritional content, this was due to phycological properties, differences in intramuscular fat content and muscle fibre type.

Older consumers selected lamb more frequently than younger age group and there was a tendency for younger purchasers to be willing to pay a higher price for premium quality lamb. Efforts could be undertaken to further understand and address these trends.

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