Nutritional Manipulations and Its Effects on Yield and Quality of Beef

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Abstract. In recent years, innovations in animal nutrition have yielded several products in the forms of feed additives/supplements for improving feed utilization and also producing novel meat products and quality to meet the demand of consumers. Consumption of meat from ruminant animals and its derivatives is also on the increase. In addition, nowadays, consumers are exceedingly interested in the quality of the products they eat, especially when this refers to meat, either white or red. A large amount progress is completed in the exploitation of the nutrition of pigs and poultry than in the ruminant animals. Beef quality can be manipulated by a variety of nutritional manipulations and many have been implemented successfully in finishing operations world-wide. This paper provides a brief overview of beef quality and the manipulation of beef quality through feeding.

Keywords: nutrition, beef quality, feed additives

1. Introduction

Meat is a major product of animal farming system and is generally referred as the flesh of animals that typically live on land, such as chicken, cows, sheep or pigs. Good nutritional management of farm animals for food production is important to ensure all farm animal-derived food products meet consumer’s demand and safety standards.

Meat quality refers to the different characteristics of the meat. Tenderness appears as a key feature of quality and variations in tenderness influence the marketability of meat particularly beef that consist of edible muscle, connective tissue and associated fat. Other attributes of beef quality is taste, juiciness, freshness, leanness, healthiness and nutrient content. Its tenderness is affected by several factors such as the muscle fiber type, composition and the buffering capacity of the muscle, animal’s breed and nutritional status of the animals [1,2]. Although animals’ genetics contribute significantly to the variation in beef quality, nutrition is one of the most important environmental factors that affect meat quality [3,4].

Recent studies on antibiotic alternatives and methane inhibition have resulted in effective feed additives being developed for use in the beef industry. Even though many feed additives are effective,
their practical implementation has been held up by the inconsistent animal responses under experimental conditions and increased cost of beef production [5].

2. Feeding for Improving Beef Quality

Beef quality can be manipulated by nutritional interventions as practiced successfully in feedlots world-wide. Today, the challenge is progressively more towards the use of nutritional technologies to produce consistently highquality beef and nutritional involvement is most significant. Species, breed, sex and the duration of feeding treatment can influence to varying degree the extent of these dietary improvements. Furthermore, feed efficiency is influenced by many factors, including variation among animals which is related to the interaction of many biological processes, physiological status and various managements [6].

Improving beef quality through feeding is more realistic and cost effective than new breeding strategies and management techniques. On the other hands, beef processing techniques such as extended ageing and trimming of carcass fat to improve beef quality are long and expensive process compared to appropriate feeding strategies even though, aging technique have positive effects on consumer perception of tenderness of beef muscles [7, 8], acceptability of its flavor [9] and improve eating quality attributes of beef [10, 11].

The effects of feeding on beef quality are generally considered with respect to the content and composition of the lean and fat tissues. Previous works have reported significant changes in ruminants, particularly on the fat component [12-15]. Studies on the effect of feeding on attributes such as the color, some nutrient content (protein, fat mineral and vitamin content), tenderness, aroma, flavor, acceptability and taste of the final product have been reported by Webb [4] and as summarized in Table 1.

| Constituent                          | Degree of the effect                           |
|--------------------------------------|-----------------------------------------------|
| LEAN                                 |                                               |
| Protein content                      | Negligible effect                             |
| Amino acid profile                   | Negligible to small effect                     |
| Lean color                           | Large effect                                  |
| FAT                                  |                                               |
| Fat content                          | Large effect                                  |
| Fat color                            | Large effect                                  |
| Fatty acid profile                   | Small, but significant effect                  |
| n3/n6 fatty acid ratio               | Small, but significant effect.                 |
| Conjugated linoleic acid (CLA)       | Small, but significant effect                  |
| MINERALS                             | Small, but significant effect on certain minerals only |
| VITAMINS                             |                                               |
| Fat soluble vitamins                 | Large effect                                  |
| Water soluble vitamins               | Negligible effect                             |
| SENSORY CHARACTERISTICS              |                                               |
| Aroma                                | Small, but generally significant effect        |
| Juiciness                            | Small, but generally significant effect        |
| Tenderness                           | Small, but variable effect                     |
| Flavor                               | Small, but generally significant effect        |
| Overall-acceptability                | Small, but significant effect                  |
The effects of feeding on beef quality are more prominent on lean color, but insignificantly affect the protein content and amino acid profile. The effect on sensory characteristics is generally small, but significant. However, the effects of feeding are most prominent on the beef fat content and composition. The dietary effects on beef fat, although small, are often significant in terms of either the nutritive value, color of the product or quality or consistency of the beef that consumers would prefer. As reviewed by Therkildsen et al. [16], beef cattle reared under pasture or pasture-based silage produce beef with fishy, gamey and grassy flavor when compared to those fed concentrate. Thus, it may be valuable to include the components or additives in the ration as long as it is economically sensible and acceptable by the consumers.

3. Use of Feed Additives in Beef Cattle Feeding

Feed additives are generally defined as dietary ingredients that produce a desirable response, but have no nutritive role. It alters ruminal or post-ruminal metabolism to enhance nutrient utilization. When used purposefully, feed additives potentially enhance feed utilization, improve animal health and improving beef quality. It can be used in finishing cattle, cow-calf and extensively reared operations. The decision whether or not to use a feed additive largely comes down to profitability.

Some of these feed additives that are largely used in cattle fattening operations in the US include methane inhibitors, essential oils, probiotics/direct fed microbials, enzymes (amylolytic and fibrolytic) and buffers/alkalizers. As example, investigations in the US have shown that feeding beef cattle with high-oil microalgae will increase the healthy omega-3 long chain polyunsaturated fatty acid (PUFA) content of beef. It is believed that it can be economical if producers are able to produce this value-added beef for the market [17]. Overall, there is evidence of the beneficial effects of feed additives on performance of cattle including on the quality of the beef.

4. Conclusion

Feed costs represent the largest component of production cost in beef production. Producers should evaluate the potential strategies of using feed additives under specific feeding and economic conditions. It is uncertain of the potential of using feed additives in fattening of beef cattle in developing countries as the cost of feeding is currently high and with lessening profit margin for producers. In addition, consumers are concerned and have negative perception of the meat produced in animals consuming such additives.

However, feed additives are still being used effectively to enhance nutrient utilization, maintaining good health and ultimately for improved animal productivity including desirable beef quality. From the perspectives of research on beef production, researchers should consider evaluating the effects of feed additives particularly from local resources such as plants to enhance animal productivity including beef quality.

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