Anabolic implant strategies in beef production: A practical guide

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Abstract

Anabolic implants reduce the cost of production in all phases of beef production from suckling calves to finishing. There are many types of implants available with varying dosages and payout mechanisms. The value of different implants and implant strategies have been well documented in the literature, allowing for economic models to be easily generated based on biological outcomes. These data can aid in designing the optimal strategy for each phase of beef production across operational logistics.

Key words: beef cattle, implants, implant strategies

Résumé

Les implants anaboliques réduisent le coût de production à chaque étape de production du bœuf allant des veaux allaitants jusqu'à la finition. Il existe plusieurs types d'implants disponibles avec différents mécanismes de dosage et de libération. La valeur des différents types d'implants et des différentes stratégies d'implantation est bien détaillée dans la littérature ce qui permet de générer aisément des modèles économiques basés sur des résultats biologiques. Ces données peuvent aider à élaborer une stratégie optimale pour chaque étape de la production de bœuf pour plusieurs types de logistique opérationnelle.

Introduction

Anabolic implants have been used by U.S. beef producers to optimize gain efficiency and increase rate of gain since the 1950s.[4] Over the years, implant technology has evolved, and implants have been developed with different dosages, payout mechanisms, and carrier systems to target specific phases of beef production. The objective of this paper is to provide a practical guide to describe the different implants available for use, how to use them, and the value of implanting.

Active ingredients

Implants are generally categorized by their active ingredient as estrogenic, androgenic, or a combination. Estrogenic implants usually are classified as such because they contain estradiol 17-β (E2) or estradiol benzoate (EB) on their own or in combination with progesterone. Ralgro (Merck Animal Health, De Soto, KS) is also considered an estrogenic implant with zeranol (Z) as an active ingredient. Androgenic implants include testosterone propionate or trenbolone acetate on their own as an active ingredient. Finally, combination implants contain both estrogenic and androgenic compounds. Based on the dose and category of the active ingredient(s), implants are commonly categorized as low, moderate, or high-dose (alternatively labelled as terminal) implants. A list of anabolic implants available for use in the US and a general categorization by implant is included in Table 1 for reference. Component (Elanco Animal Health, Greenfield, IN) implants may include the addition of an extra pellet containing tylosin tartrate to help prevent infection and abscessing of the implant site after administration.

Drug delivery systems

Drug delivery occurs by compressed pelleted implants or silastic rubber implants infused with the active ingredient. The compressed pellet is the more common delivery system. During the manufacture of a compressed pellet the active ingredient is mixed with a carrier before compression and pelleting. Common carriers include cholesterol, lactose, and polyethylene glycol. The latest development in implant technology has been for manufactures to apply a polymer coating onto the pellets. The result of this coating is to cause a slower release of the active ingredient extending the payout of the implant. This coating may be applied to some or all the pellets. Throughout this paper, the term "traditional implants" will be used to describe implants without the polymer coating on pellets and "extended release implants" will be used to describe implants with polymer coating applied to some or all pellets. A list of anabolic implants available for use in the U.S. and a general description of number of pellets and coating can be found in Table 1.

Implant payout and different payout types

The term "implant payout" is used to describe the duration and characteristics of the release of the active ingredient(s) over time and practically describes how long the implant is "working" (stimulating increased anabolic action or practically improving gain and efficiency). Implants increase anabolic action for a finite period; beyond that period, the implant has diminished pay out and re-implanting

Table 1. Implants available for use in the US.

Implant	Dose[1]	When to Use[1]	Manufacturer	ANT (mg)[2]	E (mg)[2]	A (mg)[2]	P (mg)[2]	Pellets	Coated pellets	SC[3]	STCK[3]	FDLT[3]
Ralgro	LE	Calf - Flexible	Merck		36 Z			3		SH	SH	SH
Synovex-C	LE	Calf	Zoetis		10 EB		100	4		SH		S
Component E-C	LE	Calf	Elanco	29 TT Pellet	10 EB		100	4+1		SH		
Revalor-G	LC	Stocker	Merck		8 E2	40 TBA		2			SH	
Component TE-G	LC	Stocker	Elanco	29 TT Pellet	8 E2	40 TBA		2+1			SH	
Synovex-S	ME	Stocker/BG	Zoetis		20 EB		200	8			S	S
Component E-S	ME	Stocker/BG	Elanco	29 TT Pellet	20 EB		200	8+1			S	S
Synovex-H	MC	Stocker/BG	Zoetis		20 EB	200 TP		8			H	H
Component E-H	MC	Stocker/BG	Elanco	29 TT Pellet	20 EB	200 TP		8+1			H	H
Revalor-IS	MC	Initial Feedlot	Merck		16 E2	80 TBA		4				S
Component TE-IS	MC	Initial Feedlot	Elanco	29 TT Pellet	16 E2	80 TBA		4+1				S
Synovex-Choice	MC	Initial Feedlot	Zoetis		14 EB	100 TBA		4				SH
Revalor-IH	MC	Initial Feedlot	Merck		8 E2	80 TBA		4				H
Component TE-IH	MC	Initial Feedlot	Elanco	29 TT Pellet	8 E2	80 TBA		4+1				H
Revalor-S	HC	Terminal	Merck		24 E2	120 TBA		6				S
Component TE-S	HC	Terminal	Elanco	29 TT Pellet	24 E2	120 TBA		6+1				S
Revalor-H	HC	Terminal	Merck		14 E2	140 TBA		7				H
Component TE-H	HC	Terminal	Elanco	29 TT Pellet	14 E2	140 TBA		7+1				H
Revalor-200	HC	Terminal	Merck		20 E2	200 TBA		10				SH
Component TE-200	HC	Terminal	Elanco	29 TT Pellet	20 E2	200 TBA		10+1				SH
Synovex-Plus	HC	Terminal	Zoetis		28 EB	200 TBA		8				SH
Finaplix-H	HA	Terminal	Merck			200 TBA		10				H
Compudose	ME	Flexible	Elanco	0.5 OTC	25.7 E2					S	S	SH
Encore	HE	Flexible	Elanco	0.5 OTC	43.9 E2					S	S	SH
Revalor-XS	HC	Feedlot	Merck		40 E2	200 TBA		10	6			S
Revalor-XH	HC	Feedlot	Merck		20 E2	200 TBA		10	6			H
Synovex-One-Fdlot	HC	Feedlot	Zoetis		28 EB	200 TBA		8	8			SH
Synovex-One-Grass	MC	Stocker	Zoetis		21 EB	150 TBA		6	6		SH	

[1]LE=low dose estrogenic; LC=low dose combination; ME=moderate dose estrogenic; MC=moderate dose combination; HC=high dose combination; HA=high dose androgenic; HE=high dose estrogenic; BG=backgrounding in confinement

[2]ANT=Antibiotic; TT=Tylosin Tartrate; OTC=Oxytetracycline; E=Estrogenic; A=Androgenic; P=Progesterone; Z=Zeranol; E2=Estradiol 17-β; EB=Estradiol Benzoate; TBA=Trenbolone Acetate; TP=Testosterone Propionate.

[3]SC=Indicated use for sucking calves; STCK=Indicated use for stocker cattle; FDLT=Indicated use for feedlot cattle; SH=Steers and heifers; S=Steers only; H=Heifers only

is required to maintain an elevated level of growth and efficiency. Therefore, it is pivotal to understand the payout duration of the implant used, as this information is incorporated into implant strategy design. Traditional implants have shorter payout period(s) compared to the newer, extended release implants. Generally, traditional estrogenic implants have a payout of approximately 50 to 90 days, traditional low to moderate dose combinatio n implants have a payout of approximately 70 to 100 days, and traditional high dose combination implants have a payout of approximately 90 to 140 days. The extended release implants were designed to last the duration of two traditional implants (160 to 210 days), though some are indicated to last longer. Published data or manufacturer information is available for reference indicating implant duration based on the phase of production and plane of nutrition.

Value of implanting

Increased average daily gain as a result of implanting both steers and heifers has been well documented across all phases of beef production. A review of sucking calves reported a 0.097 lb (0.044 kg) to 0.11 lb (0.050 kg) increase in daily gain of suckling steers and a 0.12 lb (0.054 kg) increase for suckling heifers implanted a single time.[5] Assuming a 90-day period, daily gain increases translate to an addition 9 to 11 lb (4.1 to 5.0 kg) of saleable weight. Stockers grazing on pasture across different U.S geographical regions are expected to have a 14.0% to 16.1% increase in gain per day for steers and 10.7% to 15.3% increase for heifers.[3] Assuming the trial days on pasture (94 or 116) that equates to 19 to 27 lb (8.6 to 12.2 kg) of additional saleable weight. Most published data with respect to implanting focuses on the finishing phase of production. Duckett et al[1] compiled a comprehensive review indicating that during the finishing phase, implanting increases gain, efficiency, carcass weight, and rib-eye area while decreasing the proportion of carcasses grading USDA Choice (during a fixed DOF period or common endpoint). The variables of greatest economic importance during the finishing phase are daily gain and feed efficiency. On average combination implant strategies increase daily gain 16.2% and improve feed efficiency 10.4%.[2]

How to implant

Proper sanitation is the foundation of good implanting technique. Start with a clean implant gun and needle. Implant guns and loading mechanisms differ by manufacturer, requiring the user to become familiar with the implant gun, cartridge, and how to load and unload the gun. Replace the needle or make sure the needle is sharp, straight, and free of burrs. Use a clean implant tray with a sponge or roller soaked in disinfectant (dilute 2% chlorhexidine). Make sure the disinfectant solution remains free of debris, discard old solution and refill as needed. Disinfect the needle after implanting each animal by wiping the needle on the sponge or roller, avoid dipping the needle in solution as this often results in getting pellets wet and jamming the implant gun. If debris is present on the ear, use a brush and the disinfectant solution to clean the ear before implanting (brush with the hair). Remember to re-disinfect the needle if you must abort an implant attempt, avoid inserting a dirty needle into the animal. Besides sanitation, another key factor is proper restraint of the animal's head. Training the chute operator on the proper way to contain an animal for implanting is extremely beneficial. After proper sanitation and restraint, analyze where to place the implant. The most common site of implant insertion is in the middle 1/3 of the ear in the valley between the ribs. Avoid ear tags, old tag holes, old implants or other blemishes. A good rule is to have a thumbs distance between implant and blemish. The middle 1/3 of the ear is commonly not available because of tags or old implants, the second choice would the plateau of the ear, and the last choice is placement in the ridge of the ear. The goal is to avoid blood vessels, cartilage, and the base of the ear. Insert the needle under the skin, pull the trigger and pull out the needle. Palpate the ear to check implant placement and that all pellets are present. Commonly operators will press the insertion site to close it off, this practice likely should be avoided as it could be doing more harm than good by introducing bacteria into the open wound. In the event of a problem, push out the remaining pellets (or explant in worse case scenario) and try again in a different location.

How to train crews to implant

Creating a system that combines classroom and hands on learning is often an effective approach. Present the information in the above section and use pictures to demonstrate. Follow up with chute-side training for each crew member. Lastly, create a system for continual feedback by systematically conducting implant evaluations on each crew member. Palpate and evaluate implant sites 20-30 days after implanting and evaluate a sub-sample of the pen or the whole pen depending on time and logistics. Having the crew observe results of their implanting is an effective training tool. Granted this type training is often only feasible when cattle are fed in confinement, but aspects of this methodology can be applied to other systems. Often during evaluations old implants will be palpated and found. Crews may conclude that old implants are not working properly or that the old implant is still effective, and money was wasted by re-implanting. In a compressed pellet system, the carrier fraction of the pellets softens and disintegrates over time, but presence of carrier is not indicating presence or concentration of the active ingredient. Palpation of the pellets in the ear is not a good method to determine if an implant is still viable. Rather viability of the implant should be based on days after implanting as described in previous sections. When silastic rubber implants are used, the rubber matrix remains in the ear of the animal and will always be found by palpation regardless of the payout status. Palpation of the implant site is effective for documenting implant placement, presence of pellets, and incidence of local infection or abscess.

Practical applications

Suckling Calf

There are three types of implants available for suckling calves Z, EB plus P, and E2. In beef calves Z and EB plus P are more commonly used and both can be used in potential replacement heifer calves (both have a minimum day of age on the label). Pregnancy rates of implanted heifers is a common concern. If it is known that the heifer will be bred, then there is little value in implanting. If heifer status is unknown at the time of implanting, then the value of the additional weight sold should be compared against decreased pregnancy rates. Implanting with Z at birth (off label) resulted in a 39.0% decrease in pregnancy rate.[5] Implanting with Z at 30-90 days of age resulted in a 0.8% decrease in pregnancy which is minimal compared to the additional weight that could be sold for the non-retained heifers.[5] Implanting heifers with

EB plus P at 30 to 90 days of age resulted in 3.2% decrease in pregnancy.[5]

Waiting until weaning and implanting heifers with Z resulted in a 1.7% decrease in pregnancy while implanting suckling heifers two times with Z decreased pregnancy rate by 7.3%.[5] This data would indicate that implanting once with Z at 30-90 days or at weaning is minimally detrimental to pregnancy rate, but likely selection of the breeding population should occur before the second Z implant. Another option would be to generate an economic model comparing weight value to cost of decreased pregnancy rate to aid in making the correct implanting decision regarding re-implanting suckling heifer calves that may be retained and bred.

Stockers

Stocker cattle implants are generally categorized as estrogenic or combination and are available both as traditional and extended release implants. The days on pasture is a consideration and when days exceed 130-150 for traditional implants, re-implanting mid way through the grazing period improves gain 3 to 5%.[3] An alternative to re-implanting is to use longer duration implants. When the gain of the animal is low because of poorer nutrient status, the gain response to implant is less than if the animal was gaining at a greater rate. However, published data available would still support implanting stockers, independent of plain of nutrition.[3] Often producers will consider breeding heifers that were implanted as a yearling with a combination implant. Heifers that were bred 82 days after implanting with 8 mg E2 and 40 mg trenbolone acetate and kept on pasture exhibited a 18.0% reduction in first pregnancy rate and 3.0% reduction second breeding pregnancy rate (Tibbitts et al., 2016). Based on the data available the expectation would be that pregnancy rate would decline further with additional combination implants and little is known about the effect of extended payout combination implants on pregnancy rate. Depending on market conditions it may make sense to retain single implant yearling heifers. An economic model can easily be developed based on published data to address that question.

Backgrounders

Background rations typically are lower in caloric density verses finishing rations. The goal of the backgrounding phase is often to hold gain to a set target and therefore implant strategies for backgrounded cattle usually fall between stockers and feedlot. There are three key considerations when designing the backgrounding implant strategy: 1) read the implant label as some implants are not labelled for cattle fed in confinement for slaughter; 2) due to the lower plane of nutrition and rate of gain it likely is inefficient to use an implant with a dose greater than moderate combination; and 3) cattle ownership status at completion of the backgrounding phase. When designing backgrounder implant strategies consider the management after backgrounding. If cattle will be retained onto full feed, then accounting for the feedlot implant strategy is important. If the feedlot implant strategy is average to moderate, then utilize a low combination to moderate estrogen strategy. If cattle will not be retained or if the feedlot implant strategy will be aggressive then it may make sense to utilize moderate combination implants.

Feedlot Native Beef

In general, implant strategies that utilize combination implants optimize gain and feed efficiency over estrogenic or androgenic implants.[1] Therefore, many feedlot strategies take advantage of combination implants. Implant strategies can be broken out into moderate, average, aggressive, and duration categories. An aggressive implant strategy utilizes one or more terminal dose implants and may incorporate re-implanting more frequently during the feeding period. A moderate implant strategy is designed to avoid using terminal implants and often involves re-implanting with the same (moderate) dose implant within the ranges of initial implant projected payout days. Most implant strategies are designed to ramp up the dose over time so an average implant strategy would, for example, use a low or moderate dose combination implant initially, followed by a terminal implant. Duration strategies incorporate the extended release implants and can be aggressive, moderate, or average in design. When designing feedlot implant strategies, three main areas must be considered: 1) how the cattle will be sold; 2) the operational incidence of bullers and operational ability to manage bullers; and 3) the operational ability to easily and inexpensively re-implant cattle. If cattle will be sold without a grid or if the grid is yield based, then an aggressive implant strategy makes sense unless bullers are a challenge. If bullers are a challenge or the operation has little tolerance for bullers then a moderate to average implant strategy should be used. If cattle are sold on a grid, then a moderate or average implant strategy should be recommended. Using published biological outcomes to create an economic model is often beneficial to determine if a terminal implant should be used. Finally, if re-implanting cattle is a challenge for the operation, then an extended-duration strategy should be considered. The extended release implants in most scenarios are, at best, equal to a well managed traditional re-implant strategy but have a greater purchase cost. If re-implanting logistics are not a major concern, then an economic model is required to determine if extended release implants should be utilized.

Feedlot Dairy Beef

There are two key considerations that may necessitate dairy beef implant strategies to differ from native beef cattle strategies. First, the days on feed typically is greater than most beef animals and second, dairy beef, specifically Holsteins, have a greater incidence of behavioral problems and bulling activity. Due to these unique challenges, dairy beef implant strategies commonly avoid using high dose combination implants, and dairy implant strategies may have a greater delay before initial implant. The extended release implants could be used more frequently in dairy beef to decrease the number of re-implants required. However, data indicating influence of implant release rate on incidence of bullers should be considered when designing dairy beef implant strategies.

Conclusions

Implanting has great value across all phases of beef production. Implant protocols can be easily implemented, and the main considerations regarding implementation is sanitation, restraint, training, and practice to perfect implant technique. During the suckling calf phase, the main consideration is the plan for retaining heifers. The stocker side is also straightforward, and the main consideration is days on pasture and designing a strategy to match payout days. The feedlot sector of production can be the most complicated in terms of creating implant strategies, but if focus is centered on cattle marketing, cattle behavior, and re-implanting logistics a strategy can be designed effectively. Ample published data is available as a resource and generating economic models using published biological outcomes is the most efficient method to design a strategy. Implants are the most cost-effective technology available to beef producers and are one of the greatest assets to aid in resource optimization and cost of production reduction.

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