Using hormone growth promotants to increase beef production

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B.NBP.0397 Hormonal Growth Promotant (HGP) Use in the Australian beef industry
by **R.A. Hunter (2009)**
B.NBP.0506 Economic evaluation of hormonal growth promotants (HGPs)
by **B. L. Davies (2008)**
A.MFS.0118 HGP Literature Review
by **Evan Sergeant (2007)**

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This publication has arisen from requests from
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for clear and unbiased information on best practice use
of HGPs.

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Contents

Key messages for the use of HGPs

Some general principles can be applied to the use of hormone growth promotant (HGP) implants and to the design of programs using them.

- Daily weight gain can be increased by 10–30%, feed conversion efficiency by 5–15% and carcase leanness by 5–8%. This can represent an economic benefit of $30–80 per head over untreated animals.
- Cattle need good feed to maximise the benefits from HGPs.
- Cattle maintaining or losing weight will not respond but will not lose extra weight because of the HGP.
- Once an HGP implant program has started, it should be continued through until slaughter if growth response is to be maintained.
- Long payout HGPs are most suitable when cattle cannot be easily yarded for re-implantation.
- Growth can be promoted continuously through repeated implants with oestrogenic hormones or by alternately implanting an oestrogen and a combination implant of oestrogen plus androgen.
- Repeated implanting with an androgenic HGP will reduce carcase fatness and marbling, and may result in downgrading of carcases at slaughter.
- Implanting with an oestrogen, even repeatedly, does not affect carcase composition at full maturity, but cattle at commercial slaughter weight will be leaner.
- Repeated implantation, especially with a combination implant, will result in a reduction in eating quality.
- HGP-treated cattle are eligible for MSA grading but will be penalised to reflect the reduction in meat eating quality.
- The European Union market will not take HGP-treated animals.
- Meat from animals implanted with HGPs is safe for human consumption.

Why use HGPs?

Hormone growth promotants (HGPs), by definition, promote growth. Cattle implanted with a HGP grow faster than non-implanted animals when provided with good feed.

Actual improvements in weight gain and feed conversion will depend on many factors, but average daily weight gain can be improved by 10–30%, feed conversion efficiency by 5–15% and carcase leanness by 5–8%. This can represent an economic advantage of $35–80 per head over untreated animals.

Grassfed cattle

Grassfed cattle reliably gain about an extra 0.1kg/day while they are on good feed but the response is less during the dry season. This faster growth is especially important in northern Australia where pasture quality declines with the onset of the dry season. The additional liveweight gain from using HGPs may mean the difference between steers meeting the specifications for a higher value market or being consigned to lower value products such as grinding beef. This is illustrated diagrammatically in Figure 1.1 which shows annual growth rates and their effect on animals being suitable for various markets.

Extended or whole-of-life implant programs have been developed to keep cattle growing faster under these seasonal patterns of pasture growth. The choice of HGP program will be determined by how long there is likely to be good quality feed, which breeds of cattle are being fattened, the market for which they are being prepared and how often the cattle are normally mustered.

Faster growth and earlier turnoff on pasture

In southern Australia, fewer cattle have been implanted with HGPs since the European Union (EU) banned the use of HGPs in beef it sources from overseas suppliers. Many producers have preferred to keep their market options open by not using HGPs. This facilitates access to Australia's existing 7,150 tonne EU high-quality beef quota, as well as to the new (2010) 20,000 tonne grainfed beef quota established by the EU

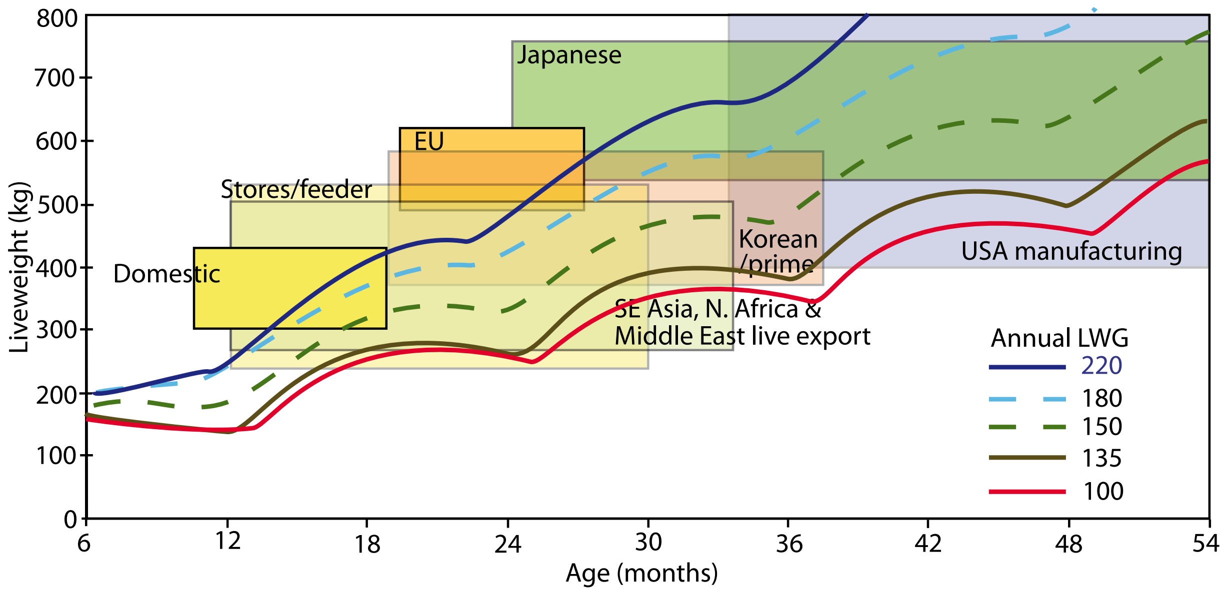


Figure 1.1. Seasonal growth curves for various annual liveweight gains (100, 135, 150, 180 and 220 kg/year) for grazing cattle in northern Australia in relation to live export and meat market specifications.

and available to eligible supplying countries—including Australia. Also, in many southern regions, their temperate pastures are of better quality and seasonal rainfall is less variable; thus, many cattle can meet the age and weight specifications for premium markets without using HGPs. Indeed, the Tasmanian Government has legislated that HGPs not be used in the Tasmanian beef industry—presumably to create a niche market for Tasmanian beef.

Feedlot cattle

In the feedlot industry, HGPs improve the efficiency of feed conversion resulting directly in lower feed costs per unit of liveweight gain. Implanting a 400kg steer being fattened for 200 days will save about 100kg of feed as fed.

The benefits from implanting steers in the feedlot range from about $25 per steer in the shortfed domestic market to $65 per steer in the longfed market. These markets would need to offer the feedlot premiums of between 5 and 13¢/kg live weight for non-implanted steers to break even with HGP-treatment.

These sorts of returns from implanting HGPs have led to about 70 per cent of feedlot cattle and 30 per cent of grassfed cattle now being implanted.

The beef industry

The 6.5 million doses implanted in 2006/07 were estimated to have contributed a total of $210 million to the Australian beef industry. Of this, $130 million came from earlier turn-off of grassfed animals while $80 million additional value to the feedlot sector was associated mainly with lower feed costs per unit of liveweight gain.

In 2007/08, the Australian national herd was 28 million head of cattle; of these, 8 million head were slaughtered to produce 2.15 million tonnes of carcase beef. If growth rate and carcase weight of implanted cattle are increased by an average of 15 per cent, use of HGPs could be responsible for 100,000 tonnes of the national beef production (4–5 per cent). On these figures, the national herd would have to increase to 30 million to produce the same tonnage if HGPs were not used.

Benefits of using HGPs

- Faster growth with good feed
- More efficient feed conversion
- Cattle reach target weight earlier
- Cattle are heavier at the same age
- Access to higher-value markets
- Northern cattle can be sold earlier in autumn so fewer store cattle are held over the dry season
- Good return on cost of HGP
- Reduced greenhouse gas emissions per kg beef produced.

However,

- Implanting is an extra procedure
- Cost of implant
- Increased feed intake per head due to heavier weights
- Cost and logistics of mustering for any repeat implants
- Reduced market options
- Less suitable for some breeds
- Changes in carcase composition at same weight
- Reduced marbling, especially with androgenic implants
- Meat less tender and downgraded under MSA
- Some feedlots do not take implanted animals
- Some bull-like behaviour
- Some prepuce prolapse
- Some consumer preferences against added hormones in meat.

Faster growth for less feed in the feedlot

2. The hormones

The hormones in implants are both oestrogenic and androgenic; they can be in the form of naturally-occurring oestradiol and testosterone or as the equivalent manufactured xenobiotics—zeranol and trenbolone acetate (TBA).

Oestrogenic compounds may be used alone or in combination with an androgen (either testosterone or TBA).

Chemical compounds used in HGP implants in Australia are:

- Oestrogen (oestradiol-17ß, oestradiol benzoate)
- Zeranol, a xenobiotic non-steroid belonging to a class of compounds known as b-resorcylic lactones
- Testosterone (testosterone propionate)
- Trenbolone acetate (TBA) – a synthetic androgen
- Progesterone.

Oestrogenic activity appears to be needed to promote growth. Oestrogenic compounds (including zeranol) are the major class of growth-promoting hormones and, with one exception, are used in all implants registered for use in Australia.

The exception contains only TBA and is intended for use in animals that produce their own oestrogen or that have already been implanted with an oestrogen.

Progesterone is included in one class of implant in combination with oestradiol benzoate. Progesterone does not promote growth but may be included because it reduces oestrogen-induced teat growth in cattle.

The androgens (testosterone and TBA), in the absence of a companion oestrogen, are less reliable growth promotants than the oestrogens.

TBA is a synthetic androgen with 3–5 times the androgenic activity and 8–10 times the anabolic activity of testosterone. In combination with an oestrogen, it promotes growth at all positive growth rates; on its own, it promotes growth only at high growth rates.

At the dose rates delivered by implants, neither testosterone nor TBA promote growth when cattle are putting on less than about 0.8–1.0kg/day.

The formulations of products currently used in Australia are listed in Appendix 1. The table in the Appendix also shows the types of cattle for which the products are registered, the types of binding matrix of the compressed pellet implants, and the withholding periods. Similar formulations of hormones are often marketed under different product names.

Some hormone definitions

Androgen = male sex hormone

Oestrogen = female sex hormone

Anabolic = constructive metabolism
eg adding muscle and bone

Endogenous = produced by the body

Exogenous = derived from outside the body

Xenobiotic = synthetic hormone

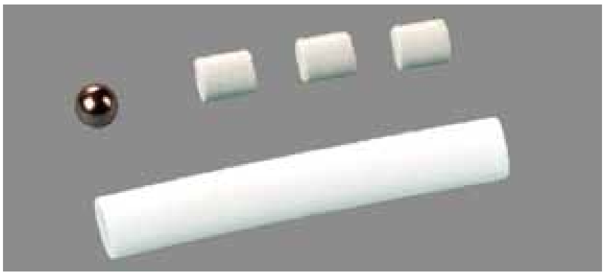
The zeranol story

Researchers in the USA observed signs of oestrogenic activity in sows eating mouldy maize. The fungus causing this activity was identified as *Gibberekka zeae,* a form of the common *Fusarium* corn mould. The active compound was isolated from the fungus and identified as Zeranol.

Zeranol is actually a mycotoxin and not a sex hormone, but has an oestrogenic action that stimulates the pituitary gland to increase production of natural growth-promoting agent. Unlike the hormones, this does not accumulate in muscle.

3. The implants

Hormones from HGPs are released into the animal's tissue from a pellet implanted under the skin in the animal's ear. Pellets may be of two types—compressed or silicon rubber.



Compressed pellet (top) and silicone rubber (bottom).

Most HGPs products are compressed pellet implants. They are made in the same way as pharmaceutical tablets by compressing the ingredients (hormone in this case) with a carrier matrix. Hormone is released as the carrier matrix dissolves when exposed to body fluids. Cholesterol is now generally used as the matrix in HGPs as it is less soluble than the lactose previously used and so slows the rate of hormone release.

The dose of the hormones is controlled by the number of pellets in the implant. For example, Revalor G (60mg TBA plus 12mg oestradiol-17ß) has 3 pellets while Progro TE–H takes 10 pellets to deliver 200mg TBA + 20mg oestradiol-17ß. The compressed pellets generally are fronted by a spherical ball (like a ball bearing) which forms a path for the softer pellets under the skin of the ear and also remains as a palpable bead that can be felt in the ear to confirm a previous implant.

This pellet of Progro TE–H has 10 pellets to deliver 200mg TBA + 20mg oestradiol with a palpable bead. The steel ball makes a passage within the ear along which the pellets can be pushed, and can be felt later to verify implantation.

The other type of pellet is used in Compudose 100, 200 and 400. In this type, the hormone (crystalline oestradiol-17ß) is impregnated into the silicone rubber coat of the pellet (Figure 3.1), and the thickness (depth) of this coat controls the duration of the payout (eg 100, 200 or 400 days) as the oestrogen has to migrate to the surface. The hormone dose per day is controlled by the length (area of surface) of the pellet. The silicone rubber implants do not dissolve but remain in the ear as a sign of previous implantation (see page 20).

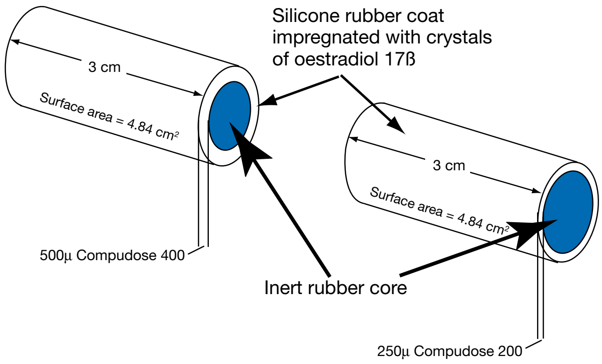


Figure 3.1. Compudose pellets with impregnated silicone rubber of different thickness for different pay-out time.

Silicone rubber implants of different length (dose per day) and different silicone thickness (duration of payout). Left to right: Compudose 200, 100, 400.

How long does the implant last?

This question is split into two parts: what is the functional life of an implant and for how long is the growth rate increased.

The functional life of an implant is defined here as the period over which the implant releases hormone, but this is not necessarily how long growth is promoted.

Compressed pellet HGP implants have been variously measured to have functional lives of between 60 and 120 days. The recommendation for most compressed pellet implants is that animals should not get a second implant within 70 days of the first—which implies a functional life of about that length of time.

Hormone concentrations in blood serum or plasma of implanted animals generally show an initial peak in the first 1–3 days, followed by a gradual depletion (see Figure 3.2).

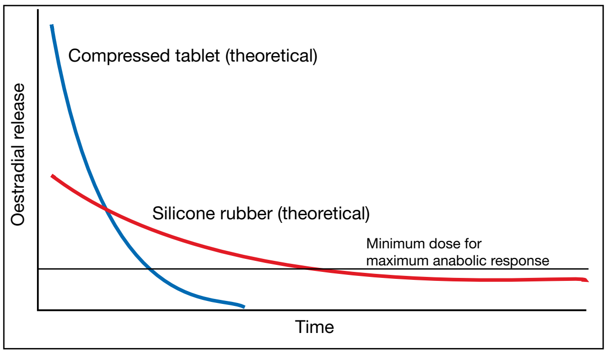


Figure 3.2. Theoretical release rates for compressed pellet and silicone rubber implants.

Silicone rubber HGP implants (such as Compudose 100, 200 and 400) have a slower release of hormone giving a much longer functional life than compressed implants (Figure 3.2). The dimensions of two silicone rubber implants with different hormone pay-out periods are shown in Figure 3.1. These implants have an initial burst of oestradiol over the first 28 days followed by a slowly declining rate of release (Figure 3.2).

How long does the anabolic benefit last?

Compressed pellet implants do not appear to promote growth (stimulate anabolic activity) for more than about 140 days.

With feedlot diets, implants containing TBA give growth responses of 30–60 per cent greater than non-treated animals during the first 28–35 days, diminishing over a 120-day period to give a final overall response of 15–20 per cent. Oestrogen alone implants do not seem to give this initial burst of anabolic activity—the growth response being only 5–10 per cent over the first few weeks.

The sustained release of oestradiol from silicone rubber implants promotes anabolic activity for almost all of the periods (100, 200 or 400 days), and promotes the growth rate response throughout the relevant period. Steers implanted with the 400-day product usually have a similar growth rate response over the whole period.

With cattle grazing pasture, the period of anabolic activity is less clear—at least for implants containing TBA. The label for Revalor 400 (60mg TBA + 12mg oestradiol-17ß) says that “improved weight gain can be expected 90–100 days post implantation in good quality healthy stock on good nutrition. The increased growth in this period should be maintained when measured at 400 days”. This implies that growth will be promoted for about 100 days and the weight advantage will be maintained for the rest of the year. However, other trials show that this initial liveweight advantage cannot always be maintained.

4. Effects of HGPs on cattle

The anabolic actions of HGPs result in more of the metabolisable energy intake going towards building protein than to depositing fat. As muscle has a lower energy content than fat, less energy is required to be comsumed per unit of liveweight gain at comparable stages of growth in implanted cattle.

Overall effects of HGPs

- Heavier weight for age
- Until they reach their mature body composition, implanted cattle are likely to be 5–8 per cent less fat.
- Less fat and reduced eating quality at a constant carcase weight.

or

- Heavier carcase at the same fat levels as untreated animals.

Carcase composition

Cattle implanted with growth-promoting hormones, especially the androgens, deposit more protein, and this is often at the expense of fat. Treated cattle grow bigger and heavier than those not treated and reach maturity at a higher mature body weight.

This has commercial implications for markets that require a certain degree of fatness at a given liveweight. In later-maturing breeds where fat cover may be marginal for a particular market, implanting HGPs containing an androgen may mean that the animals achieve the specified weight at a younger age but fail to meet the desired fatness—especially when subjected to a whole-of-life HGP program.

For markets that want muscle and less fat, implanting early-maturing breeds with a combination of androgen plus oestradiol in the months before slaughter may reduce excessive fat.

Although implanted cattle are about 5–8 per cent leaner at any given bodyweight, differences in carcase composition at slaughter will depend on the type of implant, for how long the implants have been given, the stage of growth at which the cattle are implanted and the maturity type of the cattle.

Fat thickness may be inadequate when HGPs are implanted in late-maturing breeds and the animals are sold at a specified weight. (Left) Adequate fat cover. (Right) Insufficient fat cover may result in a price penalty.

The hormone composition of the implant influences the relative deposition rates of fat and protein and the differential growth rates of different muscles. Bulls produce leaner carcases than steers because they have less subcutaneous and intramuscular fat. Similarly, implants containing testosterone or TBA produce leaner carcases at the same end date and the muscles, especially of the neck, are heavier.

Feedlot heifers treated with TBA and oestradiol also have less fat and increased meat yield—but primarily in the lower-value cuts.

Heifers treated with TBA and oestradiol have less fat and more meat—but primarily in the lower-value cuts.

The effect of HGPs on marbling (intramuscular fat content) is not clear—with many conflicting reports. Oestrogens alone have minimal effect on marbling score at the same carcase weight, but adding TBA may reduce the score, especially when the combination implant is given early and then repeated in the feedlot.

Cattle start depositing intramuscular fat as early as 4–12 months of age, and this may be delayed by implanting androgens during this period. Any negative effect on marbling could be reduced by not implanting or using oestrogen-only during the early life of an animal and then a combined implant at induction into the feedlot.

Growth rates on pasture

Cattle implanted with HGPs start to respond immediately, and the growth response, over a whole mob, is reasonably predictable. Numerous trials have been carried out on grassfed Brahman, British and European cattle and their crosses in northern and southern Australia.

The use of implants increases growth with cattle on pastures generally gaining about 0.1 kg/day extra with the relatively short-duration implants.

The situation with longer-acting Compudose 400 is more complex. Year-long trials in northern Australia include a wet season with moderate weight gains and a dry season with low weight gains, no gains or even weight loss. When the average growth rates were 0.3 kg/day, the implant added an average 0.06 kg/day; when growth rates were 0.6 kg/day, the implant added 0.09kg/day. The average over 40 trials was an additional 0.07kg/day or an extra 28kg over the 400-day life of the implant.

Implanting an HGP in cattle on good pasture can boost their weight gains by an extra 0.10–0.13kg/day.

The nutritional value of the pasture is obviously a most important factor. Whereas on tropical pasture in Queensland, implanting Compudose 400 in steers may generate additional gains of only 0.07kg/day over 400 days, the equivalent implant in young steers on good-quality temperate pasture can boost the base rate of 0.7kg/day by an extra 0.13kg/day or 35kg over 266 days.

HGP effects during periods of weight loss

Implanted cattle do not appear to be disadvantaged during periods of liveweight loss. Although increased growth hormone activity increases metabolic rate and maintenance energy requirements, HGP implants (even those containing combinations of hormones) do not appear to increase weight loss.

Table 4.1. Improvements in weight gains with HGP over a range of trials

Treatment	Total weight gain (kg) over 400 days
Oestrogen and androgen alternating every 100 days	300 (+50)
Oestrogen, then oestrogen repeated every 100 days	293 (+43)
Non-implanted	250

Treatment	Total weight gain (kg) over 302 days
TBA + Oestradiol-17ß	190 (+37)
Non-implanted	153

Treatment	Total weight gain (kg) over 420 days	
	Feedlot	Pasture
Oestradiol-17ß every 100 days	327 (+34)	374 (+39)
Non-implanted	293	335

In the feedlot

Numerous experiments in the US show that the average increase in liveweight gain from using HGPs is 18 per cent, the average increase in feed intake expressed as kilograms per day is 6 per cent and the average increase in feed conversion efficiency is 8 per cent.

Commercial results under Australian conditions may depend on many factors, but daily weight gain can be improved by 10–30%, feed conversion efficiency by 5–15% and carcase leanness by 5–8%. This can represent an economic benefit of $35–50 for the cost of implanting the HGP.

For single implants, the hormone formulations that give the highest growth rates are those that give the best feed conversion efficiencies. Combining TBA with oestradiol is better than oestradiol alone but, with multiple implants, no one strategy gives superior efficiency irrespective of whether the animals are on grass or later in a feedlot. Repeated doses of TBA may affect carcase composition and have a greater negative impact on meat quality.

Feed intake

Implanted cattle, in feedlots or on forage, eat more feed (about 6%) per day because they are heavier and not directly because of the hormone treatment.

Feed conversion efficiency

Better feed conversion efficiency with HGP treatment is of prime importance for feedlots because the feed costs per unit of liveweight gain are lower.

An eight per cent improvement in efficiency from implantation for a steer gaining 1.25kg/day on a grain-based diet of 12MJ/kg dry matter would have the following effects:

Daily weight gains improved by 10–30%, feed conversion efficiency by 5–15%.

- implanting a steer entering the feedlot at 300kg liveweight and gaining 100kg will save 18kg of feed (569kg v. 587kg)
- implanting a steer entering the feedlot at 400kg and gaining 250kg will save 76kg of feed (1849kg v. 1925kg).

Pre-feedlot implants

When grassfed cattle enter a feedlot, their implant status may not be well-defined—despite a Vendor Declaration. If an animal still has a functioning implant, double dosing could affect behaviour in the feedlot, and carcase and eating quality.

Risks from overdosing

Approved guidelines for use of the products are prominent on the label. Thus common recommendations are:
'Use only one implant per animal', 'Do not reimplant sooner than 70 days after the last implant'.

The risk from an unintentional double implant appears to be low ***but the practice is definitely not condoned***.

- In trials, treatment with up to 10 times the normal dosages of testosterone and zeranol raised the levels of hormone in edible tissues above the threshold values for human consumption.
- Giving animals three times the label dosage of TBA and oestradiol benzoate resulted in excesive levels in the liver but concentrations in muscle, kidney and perirenal fat were acceptable two months after treatment.

Do today's cattle respond differently?

It is almost impossible to test whether today's cattle lines, which have been selected for growth rate over a period of years, respond differently to HGPs than those before selection.

Of the many factors that can influence growth rate and that are often being selected for, few are substantially influenced by HGP treatment. American research in feedlots shows that growth rate and feed efficiency responses to HGP treatment that are still in the ranges that were reported twenty years ago.

Early- and late-maturing cattle

Both early- and late-maturing breeds respond to HGPs although late-maturing breeds could be expected to grow faster for longer than the early-maturing breeds. At any given liveweight, late-maturing types are in a more anabolic growth phase than early-maturing breeds. HGP treatment increases the intensity and duration of this anabolic activity.

Overall, early-maturing breeds may not respond to HGPs as much as do later-maturing types.

As building one kilogram of muscle requires less dietary energy than depositing one kilogram of fat, cattle gain weight faster early in life. Thus, with plenty of good-quality feed, late-maturing breeds could be expected to grow faster for longer than would earlier-maturing breeds (Table 6.1).

Fertility of breeding females

HGPs should not be used in breeding females as both oestrogen and androgen implants can impair development and function of the ovaries and development of mammary glands.

Sometimes the pregnancy status of a cow is not known and a pregnant cow may be implanted to increase her weight before slaughter. If the cow is in mid- to late pregnancy, the ovary is relatively dormant and the pregnancy is maintained by the large amounts of hormones produced by the placenta. In this case, the small amounts of additional hormone from an implant have a relatively minor effect on reproductive function. The cow might gain some extra weight at the expense of the calf but milk yields and calf growth rates in the first 8 weeks of lactation probably will not be affected. If the pregancy is in the first trimester, the calf may be aborted.

Bulls for meat production

Bulls have less subcutaneous fat, less marbling, less kidney fat, larger muscle areas, and lower carcase quality grades than steers. Young bull calves are traditionally castrated to make them easier to manage in the paddock and to produce a more marketable carcase. Castration is, in effect, the most common method of hormonal modification. Removing the testes reduces the production of the males' natural anabolic steroids—testosterone and oestradiol. Leaving the bull intact allows them to achieve good growth rates without the need to give externally administered hormones.

The bull's response to HGPs depends on its stage of growth. Before puberty, they generally grow 5–23 per cent faster. From about 9 months of age (250+kg liveweight), the growth response is inconsistent, presumably because their natural hormone production is generally sufficient.

Table 6.1. Heifers of earlier and later maturity type (implanted with 200mg TBA and 20mg oestradiol) attained the same body composition as non-implanted controls but at different weights and with different periods of feeding.

Heifer maturity type	Weights and number of days fed for 10mm P8 fat				
	not implanted			implanted	
	days fed	kg	kg/day	kg	kg/day
Later maturing – Angus x European	130	409	0.97	443 (+34)	1.23
Earlier maturing – Angus	94	387	1.11	403 (+16)	1.28

However, there is a more consistent effect on carcase composition. Implanted bulls nearly always have a fatter carcase, with thicker subcutaneous fat and more fat between muscles. This effect is opposite to that seen in treated steers and the reasons are not understood.

The general finding is that bull meat has acceptable eating quality, though slightly below that of comparable steers.

Behaviour and side effects

The labels of HGP products carry the warning that vaginal, rectal and preputial prolapse, increased bulling activity, hightail, sunken loins, ventral oedema and udder development may occur as a side effect of treatment. However, the overall incidence of all these effects seems to be less than 0.5 per cent of animals treated.

Possible side effects of HGPs – teat growth promoted by oestrogen

Implanting HGPs causes minor changes to the animal's appearance and behaviour or social interactions with other animals. Some steers treated with heavy doses of TBA may become aggressive soon after implantation and difficult to manage.

Some side effects are desirable. Suppressing oestrus activity in feedlot heifers for up to 100 days with TBA should allow the full growth response to the implant as oestrus-related activities can reduce the efficiency of feed conversion and impair growth.

TBA is three to five times as androgenic as testosterone, and repeated implants can lead to development of bull-like characteristics. Forequarter muscle in steers and heifers may increase.

Repeated implants of TBA can increase the incidence of dark-cutting meat.

TBA may increase the incidence of dark-cutting meat as any bullish activity during transport and in the yard at the abattoir depletes glycogen in the muscle. However, the low percentage of dark-cutters (less than 1 per cent) can be managed and reduced further if cattle are slaughtered more than 100 days after the last implant.

Feedlot heifers given oestrogen as the final implant can have a higher incidence of dark cutting than those given oestrogen plus TBA as the final implant. However, dark-cutting more often results from the off-label use (for example using heifer products containing a high dose of androgen in steers) and over-use (double or triple implanting).

Prolapse of the prepuce from HGP use is more common than vaginal or rectal prolapse. Loose-pizzle tropical breeds such as the Santa Gertrudis and Brahmans are affected most while *Bos taurus* breeds appear to be unaffected.

Age at first implant appears to have an influence on the risk of prolapse; implanted calves or weaners are not affected whereas

Possible side effects of HGPs – prolapsed prepuce steers implanted for the first time as adults may be. Prolapses are most likely to occur soon after implantation when there is a surge of new hormone(s) into the system of the animal.

Hightail is another condition thought to be associated with relaxed ligaments but does not affect carcase or meat quality.

Bulling, when a steer is repeatedly mounted and ridden by other steers, increases with HGP in both feedlots and on pasture.

Possible side effects of HGPs – bulling

Meat eating quality

HGPs can affect the eating quality of beef, with androgen and combination implants having a stronger effect.

The higher the accumulated dose of HGP over the animal's life, the greater the reduction in meat eating quality.

Eating quality can be improved post slaughter by ‘tender-stretching’ and by 'ageing' but both entail an additional cost.

Example of a meat carton label specifying how MSA grade improves with ageing for 2 weeks and for 3 weeks.

HGPs and MSA

Meat Standards Australia predicts eating quality of meat from easily measured characteristics of the animal, its husbandry and its carcase attributes such as meat colour, pH, ossification and fat depth.

The use of HGPs does not prevent a carcase from MSA grading but will affect the MSA score achieved for the different muscles. For muscles that without HGP treatment would be near the bottom for a particular MSA score (eg MSA4), the additional penalty might move them to a lower grade (MSA3) or prevent an MSA grade altogether (ungraded).

For simplicity of operation, MSA grading does not differentiate between different implant formulations, single or repeat implantation or stage of growth of hormone treatment.

The use of HGP implants can have indirect effects on MSA grading outcomes. These indirect effects that impact on MSA penalties include changes to fat cover, ossification scores and marbling.

Information about the effect of various factors on meat quality can be found in the MLA 'Tips & Tools' brochures and on www.msagrading.com.au

The effects of tropical breeds, ossification, marbling, pH and tenderstretch.

Also

How MSA grades are determined

5. Implant strategies

HGPs were first registered for use in cattle in the northern hemisphere in production systems with high weaning weights and slaughter well before two years of age; short-life implants were given about three months before slaughter to finish cattle.

In Australia, especially in the north, pasture growth is highly seasonal and cattle often need 2–4 years to reach slaughter requirements; implants can be used to promote growth in the seasons when the pasture is nutritious.

If HGPs are to be used, the implant program should be planned to produce the appropriate quantity and quality of end beef product.

General principles

Some general principles apply in the use and design of implant programs:

- Cattle respond only when they are growing and not when they are maintaining or losing weight—they need good feed.
- The more frequently cattle are re-implanted, the better overall weight gain.
- Once an implant program has started, it should be continued through until slaughter if growth responses are to be maintained.
- Sustained growth can be promoted by repeat implantation with oestrogens.
- Long-duration oestrogen-only implants allow for seasonal pasture condition.
- Shorter-duration combination implants of oestrogen and androgen require high levels of nutrition to be effective.
- Repeatedly implanting an androgen will reduce carcase fatness, develop heavier forequarters and may result in downgrading of carcases at slaughter.
- Implanting an oestrogen, even repeatedly, does not modify carcase composition at full maturity, but cattle may be leaner with less marbling at intermediate weights.
- Eating quality is reduced by the use of HGPs.

Cattle on mature native pasture in winter are unlikely to respond to HGPs.

Developing a strategy

A logical way to develop a strategy is to work backwards from the sale of the desired product.

This obviously looks at the desired weight, age and fat cover of the beast, the seasonal pattern of pasture growth and the duration of benefit of the HGP so that any continuing benefit is not wasted by early slaughter.

Examples for different classes of stock are shown on pages 14–17. All have to face commercial reality—in much of Australia, good seasons are not guarenteed.

When to start

The best time to start an HGP program may depend on when animals are mustered for another purpose.

- Calves grow faster on their mothers than after weaning at the start of the dry season. If they are mustered separately for branding and weaning, implanting steer calves at branding with combined oestradiol and TBA could see them put on an extra 0.2 kg/day before being weaned.
- They could then be re-implanted with a long-acting (200–400 day) HGP to cover them through the coming dry season. If they lose weight, the implant would have no effect until it rains and they start to gain weight again. If they continue to gain weight because they are fed supplement or because of good pasture growth, the implant will continue to add extra weight.

Calves implanted with HGP while still on their mothers will gain extra weight.

- Calves first yarded for both branding and weaning in autumn could get the longer-acting (400-day) implant followed by another long-acting implant the next year. The duration (and composition) of this second implant will depend on the targeted market.
- Calves yarded for both branding and weaning in a second-round muster later in the dry season could get a shorter-term (200-day) implant, followed by another longer-acting implant in the next autumn.
- Where cattle can be mustered easily, the first implant could be given to weaners and yearlings just before the wet season. This would forego the additional weight gain while the calf is on its mother, but would not waste hormone release into a weaner that cannot respond during the dry season.

How often?

For cattle able to continually gain weight, regular re-implantation gives better weight gains than a single long-acting 400-day treatment (Figure 5.1)—but it may cost too much to muster just to implant. In northern Australia, it could be economical to muster animals just to implant if mustering costs are less than about $5 per head.

It might be more practical to implant all non-breeding cattle whenever they are mustered for other routine husbandry procedures using an implant in which the length of its activity matches the intervals between musters.

The liveweight advantage of implanted cattle lessens once the hormone stops working. This suggests that once an implant program is started it should continue through to slaughter—even though the hormone released while the cattle lose weight during the dry season would be wasted. In areas of the north where cattle cannot be mustered for some time after the wet season starts, having a long-acting implant in place 'ready to go' takes immediate advantage of good pasture once it rains.

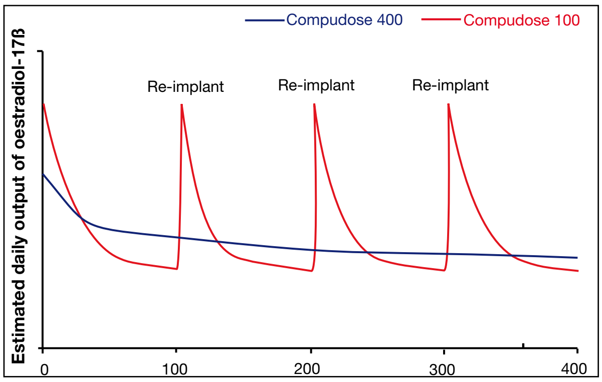


Figure 5.1. The best growth rates result from repeat implantation but this must be balanced against the extra cost of the operations. (After Hunter et al. 2000)

What to use?

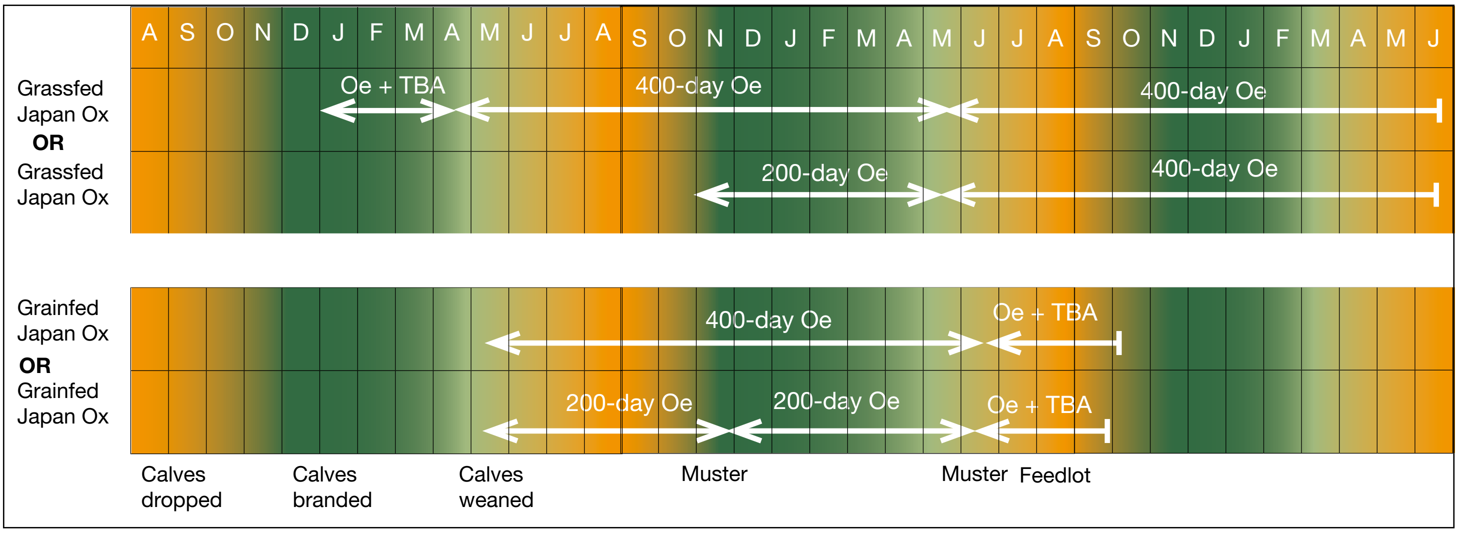
The greatest lifetime gains through the pasture and feedlotting phases are achieved by progressing through implants with low, moderate and high anabolic activity. For steers, this could mean using Ralgro, Compudose or Synovex C in the growing phase, Synovex S, Progro S or Revalor G while backgrounding or early in the feedlot, then Revalor S or one of the oestrogenic implants plus Progro T-S as a terminal implant in the late feed lotting phase.

Progro T-S is unique in that it contains only TBA and is specifically designed to be used in conjunction with oestradiol implants. For example, cattle with a functioning implant of oestradiol-only Compudose could be mustered soon after the start of the wet season and implanted with TBA to make a 'combination implant' to take advantage of the good feed. These cattle should experience a further growth boost over the wet season.

Examples of implant strategies

Japan Ox market

Figure 5.2. Suggested implant strategies for grassfed and feedlot-finished Japan Ox



Grassfed Japan Ox (550kg at 3 years)

Example for southern and central Queensland
Born: August–October
Weaned: next May–June at 180–200kg
Sold: August–October, 24–28 months after weaning
Yarded: Branding December–March
Weaning May–June
12–13 months later
when sold 12–16 months on.

Implant strategy

Give the calf a combination compressed pellet of oestrogen + TBA (100-day) at branding to take advantage of good nutrition with milk plus grass, then a 400-day implant at weaning, followed by another 400-day implant 12 months later.

OR

October – weaners can be implanted just before the onset of the wet season.

Delay the first implant until just before the expected start of the first wet season after weaning. Implant with the 200-day product in mid-September and then with the 400-day product the next year.

If cattle need to be mustered more than once a year (for say tick control during summer), giving two 200-day implants each year would give better results.

On smaller properties in southern Australia where mustering costs are much lower than in the north, more sophisticated implant strategies are possible. For example, the annual strategy could be a combination implant during the peak growing season and a 200-day silastic rubber implant for the rest of the year. A more aggressive strategy could involve a combination implant associated with peak nutrition supplemented with a couple of short-acting (compressed pellet or silastic rubber) implants to make up the other 200-odd days—especially in regions and grazing systems where cattle continue to grow over the winter months.

Grainfed Japan Ox (600kg at 2½ years)

Example for southern and central Queensland
Born: August–October
Weaned: next May at 180–200kg
Sold: 21–23 months after weaning over February–April
Yarded: branding December–March
weaning May–June

Feedlot: entry in October to November the following year at 400kg after growing out and backgrounding for 530 days at an average growth rate of about 0.4kg/day.
Sold: in February–March at 600 kg after 140 days in the feedlot at 1.4 kg/day.

Implant strategy

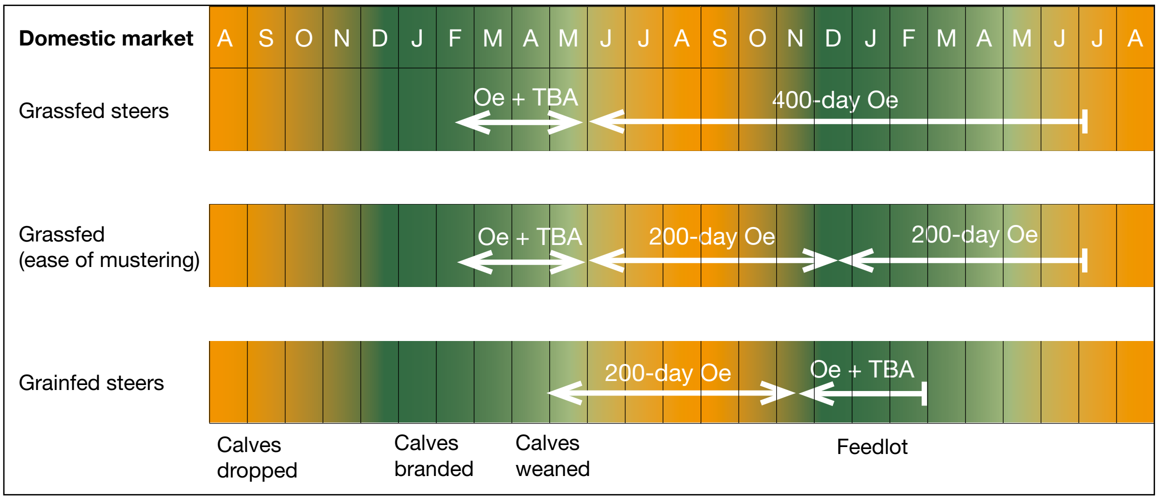
As a combined implant is likely on induction into the feedlot, it is best not to use a combination implant between branding and weaning because the accumulated dose from two combination implants could reduce eating quality—despite being more than a year apart. If, in this example, growth rates will average 0.44kg/day with an HGP, the time on grass is 530 days and this suits a 400-day silastic rubber implant in situations where mustering is difficult and costly. Where mustering is easier, two implants of 200-day product would be better; the period on grass may be able to be reduced to 400 days and the age of turnoff to below 2½ years.

At feedlot induction, a combination oestrogen + TBA as a compressed pellet will give maximum growth response but a short-acting compressed oestrogen alone pellet or the silastic rubber 100-day oestrogen product could alternatively be used. Although the steer is in the feedlot for more than 140 days, it is probably not practical or cost effective to reimplant especially since the period of increased anabolic activity is longer than the hormone pay-out period of the implant.

In southern Australian, the probability of a combination implant at feedlot induction suggests that the soft approach with one or perhaps two long-acting silastic rubber oestrogen implants would be most suitable.

Domestic market

Figure 5.3. Suggested strategies for implanting domestic market steers



Domestic grassfed steers (460kg, under 2 years)

Example for southern and central Queensland
Born: August–October
Weaned: next May at 210–240kg
Sold: 12–15 months after weaning
Yarded: branding December–February
weaning May
for sale 12–15 months later

Implant strategy

Implant the calf with a combination oestrogen + TBA compressed pellet at branding to take advantage of good nutrition on milk plus grass, then a 400–day implant at weaning. This implant would keep working until the next June when the animals would be mustered for sale. If cattle have to be mustered more than once per year (for say tick control during summer), give two 200-day implant each year.

Domestic grassfed heifers (460kg, under 2 years)

Example for southern and central Queensland
Born: August–October
Weaned: next May at 200–220kg
Sold: June–August, 13–15 months after weaning

Yarded: Branding in December–February weaning in May

Implant strategies

Given the principle that once an implant program is started it continues, the only strategy possible is to give a combination oestrogen + androgen (TBA or testosterone) implant 4–5 months before the projected slaughter date—and as long as there is good feed ahead. This should give an anabolic response until slaughter. Do not repeat combination implants because eating quality will probably be reduced. And do not implant heifers at weaning if they could be kept as breeders.

August – weaners will continue to respond to HGP during winter and spring where there is good feed.

Grainfed domestic steers (460kg at 18–21 months)

Example for southern and central Queensland
Born: August–October
Weaned: next May at 210–220kg
Sold: between February and May, 9–12 months after weaning
Yarded: branding December–February, weaning May

Feedlot entry at 350kg after growing at 0.5kg/day for 260 days; feedlot exit at 460 kg after growing at 1.4kg/day for 70 days

Implant strategy

Give a 200-day silastic rubber implant at weaning, followed by an oestrogen + TBA pellet at feedlot induction in November

Grainfed domestic heifers (460kg at under 2 years)

Example for southern and central Queensland
Born: August–October
Weaned: next May at 210–220kg
Sold: between February and May, 9–12 months after weaning
Yarded: branding December–February; weaning in May

Feedlot entry at 350kg after growing at 0.5kg/d for 260 days.
Feedlot exit at 460kg after growing at 1.4kg/d for 70 days.

Implant strategy

For reasons stated with heifers earlier, do not use repeat combination implants because of the likely reduction in eating quality. Thus no implant should be given until feedlot induction when a combination oestrogen and androgen (TBA or testosterone) is implanted. Again, do not implant at weaning if the heifers could be kept as breeders.

Cull cow market

Cull cows (450–550kg, culled for age or infertility)

Cows culled for age or infertility are generally fattened for 3–6 months over the wet season before going to the low-value market as mince or cheap stewing steak where toughness is not an issue. The aim now is to maximise the weight gain without excessive fat.

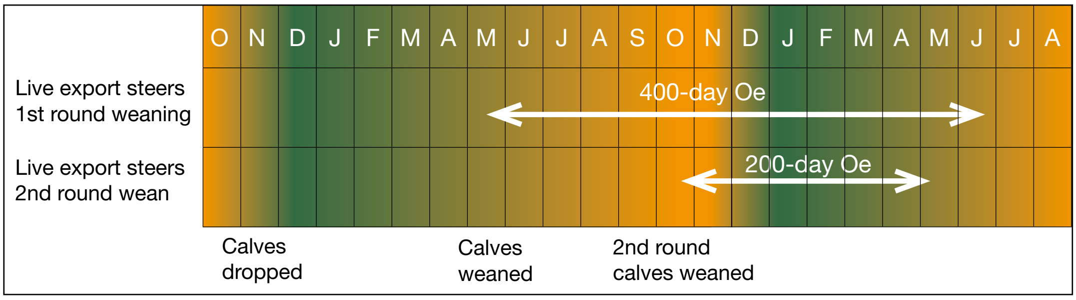
Implant strategy

For a 6-month finishing period with continual weight gain, try an initial implant of 200mg testosterone propionate and 20mg oestradiol, followed by a second implant of a oestrogen and TBA combination for females. Double androgen in two combination implants will not affect mince quality and only runs the risk of slight androgenisation. Implanting TBA last will help prevent over-fatness because of the strong testosterone attributes of Trenbalone.

If the cows cannot be mustered for a second implant or if the finishing period is only 3–4 months, one of the combination implants for females with TBA or testosterone would be suitable.

Live export market

Figure 5.4. Suggested strategies for implanting steers for live export



Live export steers (280–320kg at 20 months)

Example for far north Queensland, tropical Northern Territory and Western Australia

Early born calves dropped: October–December

Weaned: next May–June at 180–200kg

Sold: 12 months later in May

Yarded: first-round muster May–June at sale 12 + months later

Implant strategy

Use a long-acting 400-day silastic rubber implant at weaning.

For second-round steers weaned in about September, the heavier weaner steers would receive a 200-day silastic rubber implant at weaning. If they put on about 120 kg liveweight over the wet season, they should also be heavy enough to go on a boat with the first-round steers. The lighter second-round steers which may be heavy enough to sell at the start of the next wet could receive a 400-day implant, or two 200-day implants if they were in a separate paddock to the heavier ones and mustered in May.

Live export steers can benefit from a long-acting 200- or 400-day implant.

Live export heifers (280–320kg at 20 months)

Example for far north Queensland, tropical Northern Territory and Western Australia

Early-born calves dropped in October–December

Weaned: next May–June

Sold: 12 months later in May

Yarded: First-round muster in May–June

Implant strategy

Any decision to use HGPs in heifers has to consider how many replacement heifers will be needed. Most northern Australia enterprises keep 60–70% of their heifers each year as replacements, and HGPs are not registered for use in breeding females.

Over-mating is recommended to ensure adequate pregnant animals are available as replacements but empty replacement heifers will not be identified until pregnancy testing around April–May. The average weight of Brahman heifers at puberty (330kg) is higher than the specified weight for export. A 100-day or 200-day implant would not be warranted if the empty cull heifers are to be exported over the next few months.

Any HGPs for heifers should be restricted to those weaner heifers that are culled at weaning for temperament, type or conformation. These culled pre-puberty heifers can be treated with a 400-day oestrogen implant if first-round weaners or a 200-day implant if second-round weaners.

5. Buying and implanting HGPs

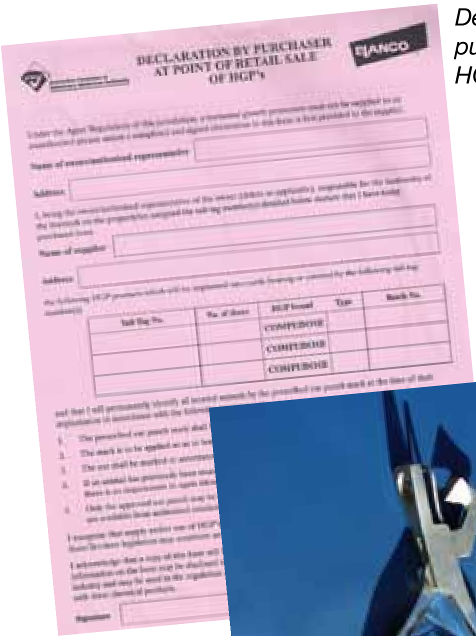
The use of HGPs in Australia is strictly controlled. Regulations cover what can be sold by the manufacturers and what can be bought by beef producers.

Regulations for use in Australia

HGPs are veterinary medicines and have to be registered through the Australian Pesticides and Veterinary Medicines Authority (APVMA). This authority has to be satisfied that when the product is used according to the label directions it will not result in any appreciable risk to:

- consumers – the public
- other persons handling or administering the chemical – the beef producer
- the environment
- other crops or animals
- trade in any agricultural commodity.

The 18 different HGP preparations currently registered for use in Australia under five different brand names (Ralgro, Compudose, Progro, Revalor and Synovex) are listed in Appendix 1.



Declaration by purchaser of HGPs

Triangular ear hole punch

When purchasing HGPs, producers have to sign a declaration form which is subsequently registered with the APVMA; they then must keep records to account for all the implants they purchased.

The rules for beef producers

The HGP user has to:

- be registered
- insert the pellet according to instructions
- identify the implanted animal with an ear mark (triangle punch)
- record the implant on the National Vendor Declaration (NVD) when the animal is sold.

It is an offence to represent HGP-treated cattle as being untreated and doing so can result in a penalty.

Types of applicator

Each manufacturer of implants tends to have its own applicator with different models for different types of implants. Some types of applicator are for the smaller operator, others for mass implantations.

Types of implant applicator

How to implant

(The following instructions are based on the Elanco Compudose Training Manual.)

HGP pellets have to be implanted correctly to obtain their full benefit and to prevent damage to the animal's ear. Poor technique may result in an infected ear and abscess.

The implants are placed in the near-side (left) ear; the ear mark is applied to the far-side (right) ear.

Preparation

Reduce the risk of infection with good hygiene.

- Clean applicators and needles before use.
- Place a tray with a sponge soaked in disinfectant near the headbail to clean the needle after each implant.
- Have a bucket of warm water and disinfectant and a brush available to clean ears soiled with mud or dung.
- Keep the implant pellets in their sealed packaging until needed.

A hydraulically-operated under-chin restraint holds the animal's head steady for more accurate implanting.

Cattle handling

The crush should be able to hold the head and neck steady, preferably using an under-chin restraint.

Load the applicator

Check that the bevel of the needle is placed upwards. Different brands of HGP use their own design of applicator but, in general, pull back the plunger and insert the pellet 'magazine'. Push the plunger forward until the pellet lies in the barrel of the needle and the plunger clicks into position.

A 'magazine' of implant pellets

An implant applicator and implants

To insert the implant, find the insertion site on the rear side of the left (near-side) ear.

Figure 5.1

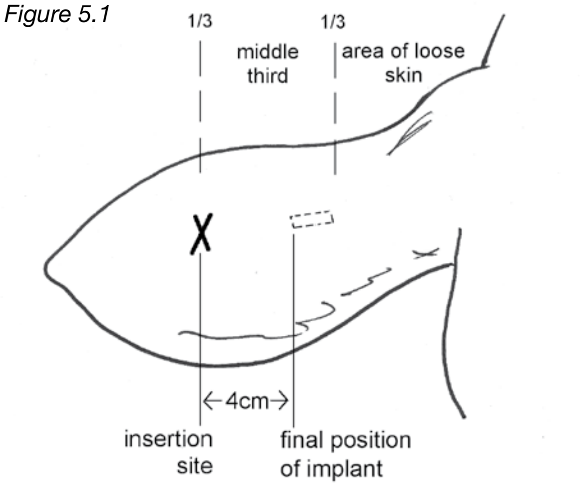


Figure 5.2

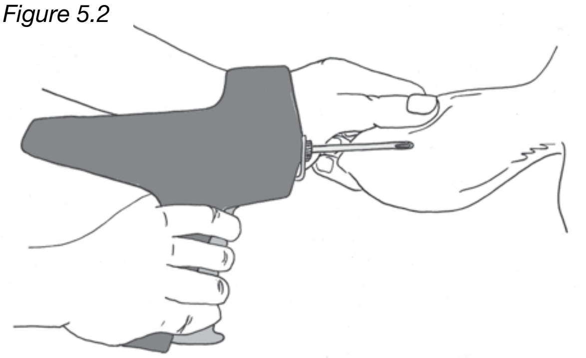


Figure 5.3

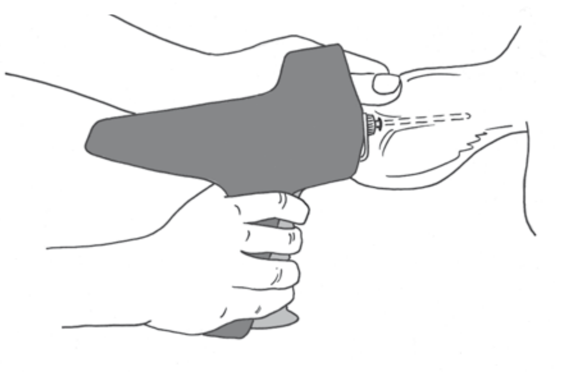
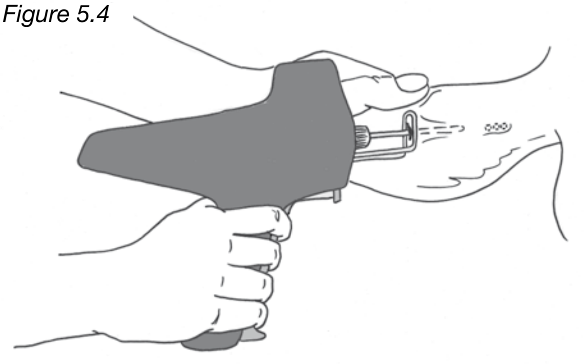


Figure 5.4



Inserting the implant

Find the insertion site

Find the insertion site on the rear side of the middle third of the ear where the skin is tight (Figure 5.1).

Clean the insertion site

Hold the near-side ear. Clean any muck from the site with the brush and disinfected water.

Insert the needle in the ear

Hold the ear in one hand and position the needle flat along the ear about 4cm from the implant site.

Insert the needle under the skin with the bevelled edge outwards (Figure 5.2).

- Take care to avoid any major blood vessel or cartilage.
- Do not insert at too deep an angle or the needle will go through the ear.
- Do not implant too close to the base of the ear as the better blood circulation there will absorb the HGP too quickly.

Place the pellet

Squeeze the trigger of the gun (or push the plunger forward) (Figure 5.3).

Pull the needle back slightly as the pellet is pushed out.

Remove the needle

Hold the trigger (or keep the plunger button pushed forward) and withdraw the needle in one smooth motion (Figure 5.4).

Seal the wound

Palpate the ear to check the pellet has been correctly placed and retained in the ear. Close the wound by pressing with the thumb and index finger.

Withdraw the needle smoothly, feel the ear to check the pellet remains in the ear. It can be seen just in front of the thumb in this picture.

Marking the implanted animal

The opposite (off-side) ear must be punched with the approved triangular hole pliers to show that it has been implanted.

The triangular hole provides a permanent sign that an HGP has been implanted.

Clean the needle

Disinfect the needle after each implantation to avoid spreading any infection. Clean the needle with the plunder extended to prevent material accumulating at the tip. Change the disinfectant solution every 50–100 head to prevent contamination of the disinfecting tray.

Reload the applicator

Depending on the type of gun, pull the applicator plunger back and reload the next pellet.

Cleaning up

At the end of the day, clean the applicator in warm water to remove all dirt and blood. Pull the gun apart, clean the inside workings and reassemble. Check that the needle is sharp and clean and re-insert it with the bevel facing upwards.

Recording

Check the number of implants used and the number remaining against the number of cattle treated through the race that day.

Safety

Dispose of any old needles and empty ‘magazines’ by wrapping with paper and placing in the garbage. Store any unused implant pellets in a sealed plastic container in a locked cupboard or refrigerator.

Previous implants can be detected by sight (Compudose) or by feeling for the steel bead after the soluble pellets have dissolved.

7. Effects on human health

Consumers are naturally concerned about the safety of their food, and especially about the effect of hormones in meat on their health. Much of this concern has arisen from historic reports of side-effects of very early synthetic oestrogens used to sterilise male chickens. The use of these early synthetic hormones in the poultry industry has long since been banned.

APVMA

For an HGP to be registered in Australia, the Australian Pesticides and Veterinary Medicines Authority (APVMA) has to be satisfied that, when the product is used according to the label directions, there will be no appreciable risk to:

- those who eat the meat
- those who handle or apply the HGP
- the environment
- other crops or animals
- the beef trade.

World-wide registration

HGPs for cattle are currently registered in Australia, New Zealand, USA, Canada, Mexico, South America (except Argentina and Brazil), South Africa and Japan; however, the European Union (EU) has banned their use and the import of products from treated animals since 1988.

Although the EU argues that hormone residues in the meat and offal of treated animals pose a risk to human health, scientific committees in North America, Australia and from international bodies (FAO and WHO) have found no evidence to support this.

The EU position

The EU position appears to be on the precautionary principle in that:

- Oestradiol-17ß is carcinogenic.
- Zeranol and TBA may have weak carcinogenic effects.
- It is not known whether other hormones used are not carcinogenic.
- Bioavailability and activity of some products (particularly synthetic hormones) is uncertain but may be higher than previously assumed.
- Activity of these hormones in pre-pubertal children is not well understood.
- Residue levels in meat may be considerably higher than represented because of misuse of implants.

World-wide reviews and consensus

Numerous reviews and evaluations of safety and public health risks associated with HGP usage have been conducted by the Joint FAO/WHO Expert Committee on Food Additives; the Veterinary Products Committee of the Department for Environment, Food and Rural Affairs (UK); the Committee for Veterinary Medicinal Products for the European Medicines Agency; the Chemical Review and International Harmonisation Section, the Office of Chemical Safety and the Therapeutic Goods Administration of the Australian Department of Health and Ageing. HGPs have also passed rigorous safety and efficacy evaluations by national registering authorities such as the US Food and Drug Administration and the Australian Pesticides and Veterinary Medicines Authority.

The consensus of these reviews and agencies is that:

- While HGPs do increase hormone levels in meat, these levels are still well within normal limits for untreated cattle (and well below Maximum Residue Limits for synthetic products).
- Hormone levels in treated meat are well below levels in many other foods (see Table 7.1).
- Meat from HGP-treated animals contributes only a small proportion of total intake of these hormones.
- The absorption and availability of these hormones when meat is digested in the stomach is low.
- The bodies of both women and men naturally produce many thousand times more oestrogen each day than found in a meal of steak (see Table 7.2).

- Age, sex, reproductive status of the consumer, and exercise can influence the levels of hormone circulating in the body.
- Although oestradiol-17ß, in particular, is recognised as potentially carcinogenic when acting as a hormone, the levels present in a diet are unlikely to increase the risk to consumers.

Thus they consider that HGPs, when used according to good agricultural practice, pose no additional health risk to consumers.

Department of Health and Ageing

A review of HGP safety by the Australian Department of Health and Ageing in 2003 concluded that "*there is unlikely to be any appreciable health risk to consumers from eating meat from cattle treated with HGPs according to good veterinary practice*". They also noted that: "*to adequately determine the incremental risk associated with very low levels of HGP residues in meat, the total dietary intake of hormones from all sources would need to be evaluated.*"

Natural hormones in the human diet

The US Food and Drug Administration has said (USFDA, 2002):

"*Consumers are not at risk from eating food from animals treated with these compounds because the amount of added hormone is negligible compared to the amount normally found in the edible tissues of untreated animals and that are naturally produced by the consumer's own body*".

Hormone levels of treated and untreated beef and of some other components of our diet are shown in Table 7.1.

Table 7.1. Oestrogen contents of some common foods

Food items	Oestrogen content (ng)
Beef (300g) from HGP-treated steer	7
Beef (300g) from cow	45
Beef (300g) from pregnant cow	420
Milk (500mL)	75
Eggs (50–60g)	1,750

ng = nanogram = one billionth of a gram

Oestrogen production in humans

All humans produce oestrogens naturally and continuously secrete them into the bloodstream. These natural productions of endogenous hormones are shown in Table 7.2.

Table 7.2. Natural production of oestrogen by the human body

Normal oestrogen production in humans (ng per day)	
Non-pregnant woman	480,000
Pregnant woman	3,415,000
Man	136,000
Male child (before puberty)	41,500
Female child (before puberty)	54,000

ng = nanogram = one billionth of a gram

8. Economics of using HGPs

HGPs are used widely in both the grazing (grassfed) industry and the intensive feedlot industry to increase the growth rates of beef cattle.

In grassfed beef systems, the economic benefits from using HGPs can come from:

- higher growth rates per day.
- animals can be sold at heavier weights at the same age, or
- animals can be sold earlier at similar weights.
- higher prices if better growth rates result in premium markets.
- earlier sale of non-breeding cattle allows more breeders to be run on the same area.

In feedlots, benefits are mainly from:

- higher feed conversion efficiency.
- greater throughput as animals reach the target weight more quickly.

Grassfed systems

As most HGP use in the grazing sectors occurs in northern Australia, the following evaluation compares four different enterprises—Japanese ox, bullock, feeder steer and live cattle export—with and without HGP. Likely turn-off weights and ages for each enterprise are estimated, and improvements in gross margin from using the HGPs are calculated. These are divided by the number of doses to get an average improvement per dose.

Economic analyses

Gross margins gains from the use of HGPs are shown in Table 8.1.

Calculated improvements per dose of HGP ranged from $14 for Japanese bullocks to $51 for feeder steers.

Price discounts v. weight gain

As some markets will not accept animals treated with HGPs, beef producers have to calculate whether the gain from the extra meat produced is worth more than any price discounts. Similarly, those targeting the MSA market need to compare the direct and indirect benefits from using HGPs against the loss of any premiums.

There is currently no discernable price discount against HGP use in our main markets. However, discounts required for the HGP treatment to break-even with the no-HGP use would be:

- Japanese Ox 10¢/kg lw
- Feeder steer 27¢/kg lw
- Bullock 7¢/kg lw
- Live steer 15¢/kg lw

(Note – in recent years, the EU premium has ranged between 10 and 50c/kg cwt. It can vary depending on the supply, EU demand, quota levels and the Australian dollar, but there have been times when there was no premium.)

Impact of capital invested

Table 8.1. Key gross margin (GM) results for various grazing enterprises

	Japanese Ox	Feeder steer	Japanese bullock	Live export
No. of breeders if using HGPs	1,000	1,000	1,000	1,000
No. of breeders if not using HGPs	981	914	960	947
GM if using HGPs excluding HGP costs ($)	387,150	347,408	328,567	224,336
Cost of HGPs ($)	4,088	4,275	4,883	2,858
GM including HGP cost ($)	383,063	343,133	323,684	220,860
GM without HGP ($)	367,487	308,266	314,195	209,742
Difference in GM ($)	+15,576	+34,867	+9,489	+10,920
Number of implants given	654	684	800	428
GM gain per implant (dose)	$24	$51	$12	$26

Note. Prices and costs as at May 2008

The use of HGPs and the earlier turn-off of sale stock means that more breeding cattle can be run, and so more capital is tied up in breeding stock. However, this is almost completely negated by the number of sale animals that would have to be held for longer before they can be sold. If an enterprise starts using HGPs, the initial cash flow benefit, excluding the cost of the implants, comes from more cash being received earlier but the total breeding herd would have to be increased for the full benefit of HGPs to be recouped.

Side benefits of using HGPs

Using HGPs without increasing stocking rates will improve land condition. The value to the environment in this case can be regarded as the opportunity cost of the income foregone by not increasing the stocking rate.

The improved efficiency in feed conversion allied to a reduction in grazing pressure will reduce overall emissions of methane associated with ruminants.

Total benefits to grassfed production

There appears to be considerable variation in the enterprise performance from HGPs, and results will be quite sensitive to the assumptions made. It would be reasonable, however, to assume that the benefits from HGP use range between $20 and $40 per dose.

Given an estimated 4.56 million doses are used in the grazing industry with an estimated average return of $29 per dose, benefits to the grassfed industry are around $130 million.

Feedlot industry

The feedlot industry was subdivided into three sectors (with the estimated proportion of the total feedlot numbers in brackets):

- shortfed (80–90 days) domestic (39%)
- shortfed (114–130 days) export (49%)
- longfed (170–195 days) export (12%).

In this analysis, all cattle were bought at the same weight but the untreated ones took longer to finish.

Additional gross margin returns from HGPs were calculated to be $23 for the shortfed domestic system, $49 for shortfed export and $64 for long-fed export.

Total costs for HGP treatments can be $7.00 for one treatment, $12.50 for 2 treatments (beast sold around 30 months of age) and $18 for 3 treatments (beast sold around 42+ months of age).

Sensitivity analysis

The two key factors driving the economics of feedlotting are the cost of feed and the margin between buy-in and sell-out price.

Feed prices are constantly being influenced by droughts, world demand for grain for use as bio-fuels, and energy prices. To test the sensitivity to grain prices, prices of $200, $300 and $350/tonne were used in Table 8.2.

As feed prices (and hence costs) increase, the better feed conversion efficiency from using HGPs increases the difference in gross margins.

Table 8.2. Improvements in gross margins between HGP treatments and no HGP (buying at same weight and taking longer to finish) under different feed prices.

Feed price $/tonne	Domestic	Shortfed export	Longfed export
$200	$18	$39	$52
$300	$28	$58	$76
$350	$33	$68	$88

Buy-in and sell-out prices at $2.15/kg LW for the domestic market and $2.05/kg for the short-fed export market.

Conclusions for the feedlot industry

- Unless premiums are paid for non-HGP treated products, the benefits from using HGPs are significant. They varied from $23 per steer in the short-fed domestic market to $64 per steer in the long-fed market.
- Premiums required for gross margins of non-HGP treatments to break-even with the HGP treatment varied from 5 to 13 ¢/kg live weight (Table 8.3).
- Not using HGPs but buying in heavier

Table 8.3. Premiums required for gross margins of non-HGP treatments to break-even with HGP treatment

Feedlot system	Domestic market	Short-fed export	Long-fed export
	Premium required (cents/kg)		
Implant HGP to reduce days on feed			
No HGP, buy same wt as above, take longer to finish	5	8	10
No HGP, buy heavier wt, sell same days as HGP treatment	7	10	13

animals to feed for the same number of days as for HGP-treated animals always gave lower gross margins than buying lighter animals and feeding them for longer.

- The cost to the feedlot of a longer turn-around has not been factored into these calculations but the interest on the capital invested in the stock is included. If the overhead costs involved in the feedlot were taken into account, the case for implanting with HGPs is stronger because throughput is greater.
- For the live export market, when feed prices reached $250 per tonne, the selling price/kg needed to be higher than the purchase price/kg for profitability.

Total benefits to the beef industry

In the 2007/08 year, 8.05 million head were slaughtered. Based on the number of implants sold, about 50% of the slaughter generation cattle (4.1 million head) would have been implanted with an average of 1.5 implants per head.

Total benefits of HGP use for the whole of the beef industry are estimated to be around $210 million—$130m for the grazing industry and $80m for the feedlot industry.

The benefit for the grazing industry came from gains produced by the nearly 4.6 million doses used (in 2006/07). Additional value can occur because more breeders can be carried when HGPs are used. The benefit for the feedlot industry was calculated from the gains from an estimated two million treatments.

Use of HGP implants helps boost the profitability of both grazing and feedlot sectors by increasing weight gains without discernable price penalties from the target markets.

Although there are considerable economic benefits in using HGPs, their use has mainly been confined to northern Australia.

Beef producers need to compare the benefits of HGPs against the loss of market options and premiums such as for domestic MSA grading and for international markets such as the EU.

Beef producers in southern Australia who are producing for markets where there are no price penalties or bans on the use of HGPs might consider using them to increase their productivity and returns.

From backgrounding to feedlot on HGPs

The Ten Mile Cattle Co property is about 2,500 hectares of brigalow–belah to box–sandlewood grazing country 50km north of Goondiwindi. Partners Peter Fox and Andrew Richardson have backgrounded cattle before finishing them in the company feedlot.

Andrew and Renee Richardson at the Moruya Feedlot Goondwindi with cattle being fed for the ACC/ Coles program"

The brigalow-belah and box soils had been planted to Bambatsi, buffel, and panics but, under cell grazing, the valuable soft Queensland bluegrass has increased. About 200 hectares of leucaena have been planted in what, at 28°S, must be one of the most southern commercial plantings of the shrub legume. Long-term rainfall is 550mm but has averaged only 500mm over the last seven years. Water medicated with urea is reticulated to each grazing cell.

Steers and heifers, ranging from Brahmans, high-grade European breeds to pure Angus are purchased at 200–250kg; they are backgrounded on the pasture and leucaena to about 350kg before entering the feedlot. Initially, the feeder animals were implanted with Revalor G but the recent years have been too dry for the necessary forage growth. Andrew switched to Compudose which seemed to give better results during the variable seasonal conditions. The dose depended on the weight of the animal and how long it would need to be on grass to be ready for the feedlot. Lighter stock at 200kg received Compudose 200, those over 250kg received Compudose 100.

On induction into the feedlot, most animals received a further implant, this time of Synovex H or Revalor H for heifers, before being fed for

Brahman cross heifers being backgrounded with Compudose on Bambatsi and Queensland bluegrass pasture.

Brahman cross heifers being backgrounded on oats with Compudose G north of Goondiwindi.

50–60 days to reach 450–500kg. Pure British heifers sometimes put on too much fat before reaching the target grid weight range and some lines did not need to receive any HGP to prevent them getting too fat over the feeding period.

Andrew's observations

- Brahman and high-grade European cattle had good weight gain with HGPs but may not put on enough fat (5–6mm) unless kept in the feedlot for longer than 50–60 days. Some high grade European cattle were not implanted for this reason.
- Cattle need to go onto good forage to show the benefit from Revalor G, but those on Compudose 200 will benefit when the season improves and feed quality increases.
- Two implants of Compudose 100 may give better results than one of Compudose 200 but this does not justy the logistics and cost of an extra mustering.
- Purchased heifers that might be in early pregnancy may abort with implants but those in later stages are not affected.
- Some commercial feedlots do not like to buy implanted feeder cattle because the NVD does not show the dose, type or timing of implants, and HGPs may restrict their market options.
- Some markets will accept cattle with oestradiol HGP but not with TBA; other markets do not differentiate.
- Even some high-grade Brahman cattle implanted with HGP can reach MSA grade.
- Producers will continue to use HGPs until the markets pay sufficient premium to cover the lower growth rates of non-implanted animals.
- HGPs are much more common in grassfed cattle in north Queensland than in the southern parts of the state.

HGPs for grassfed beef

Brad Snow fattens about 200 steers each year off about 100 hectares of improved pastures near Yungaburra on the Atherton Tableland. He does this with the help of an average of 1,500mm of rainfall, good basalt soil and HGPs.

Fertilised improved pastures

Brad's improved pastures of mainly signal grass with Nandi setaria, guinea grass and the legume Tinaroo glycine are top-dressed with 250kg of diammonium phosphate every second year. Cattle are kept in one mob and rotationally grazed around the property at an overall stocking rate of 1 head on 0.5 hectares.

European cross steers for local trade

Brad buys in store steers, ideally 300kg, milk tooth and not too much hump, and fattens them for a local butcher. Most of the animals are European-cross types as the butcher likes their good yield. The steers put on an average of 250kg per head per year, and Brad sells them fat when they reach 500–580kg. A molasses brew is also fed in covered troughs throughout the year.

Implants of oestradiol plus TBA

When the steers are purchased, they are implanted with the HGP Revalor G, vaccinated against 3-day sickness and given an injectable wormer.

Some purchased cattle may already have a 400-day Compudose pellet in their ear and this would have been implanted some 300–350 days previously. These animals are also given the Revalor G on arrival and perform very well. Brad is now thinking about switching from Revalor G (60mg TBA+12mg oestradiol-17ß) to the stronger Revalor S (140 mgTBA + 28mg oestradiol-17ß).

He has had no health problems when using the HGP in his cattle and the Revalor G does a good job of minimising excess fat—the butcher wants 5–12mm fat at the P8 site.

Bill has owned the property since 1992 but its small size cannot provide a full income. He supplements the income from cattle by training young people to work on cattle stations, many on the indigenous properties in North Queensland.

Brad's steers on productive pastures on the Atherton Tableland

HGPs for all fattening stock

Cam and Lisa Hughes of Malarga Grazing Company breed and fatten cattle in the inland Burnett region of southern Queensland. They own and lease a total of about 19,500 hectares of blue gum flats and black speargrass–ironbark and spotted gum hills around the Gayndah district. About 9,000 hectares have been improved with Hatch and Bissett creeping bluegrass, Seca stylo, finestem stylo, Wynn cassia and lotononis. The improved country runs a beast to 1½ hectares, the speargrass slopes a beast to 3 hectares.

They target the Japanese Ox and American cow markets using 2,500 predominantly Brahman breeders with a cross of Charolais, Charbray and Droughtmaster. They fatten all sale stock—2½ to 3-year-old bullocks (usually 4–6 teeth) and the cull heifers for the Japan Ox market, and cast-for-age cows for America.

All male calves are implanted with 400-day Compudose at branding (between December and April) and then are re-implanted at 12–18 months with another 400-day dose.

Cam Hughes implanting Compudose 400 into a 2-year-old Brahman steer.

They are then finished off with either Compudose 200 or 100-day Compudose G. All female stock get just one implant of Compudose G 3–4 months before slaughter.

Implanting is done mainly in spring to maximise potential growth. Cam uses Compudose because it is giving good results and is the only HGP with a year-long payout.

Cam believes that the best results come from implanting the calf with Compudose while it is still suckling the cow, implanting further 400-day doses, and then finishing off with a 100-day or 200-day implant prior to slaughter.

Most bullocks have 3 to 4 implants over their life; the results are heavier carcases with better finished butt shape and up to 6 months earlier turn-off. He feels that some of the most impressive results come from implanting the cull cows, getting the extra weight without the excess fat.

One issue seen when using HGPs is that some Charolais/Charbray crosses steers struggle to make the required 7mm of fat by the end of the growing season and are downgraded by 10c/kg; however, Cam believes that he makes up this loss with the extra weight gain. On the other hand, he used to have a bit of a problem with 'over-fat' cows before he used HGPs on the females. Using the 100G Compudose has made a big difference by reducing fat cover, but still with enough to grade well. Cam says that they do see the occasional prolapse in steers shortly after implant but they seem to recover without any problem.

Cam has not been recording weight gains, but visual appraisal makes him believe that the cost of mustering and implanting of HGPs is minimal compared to the gains.

HGPs in the farm feedlot

Bill Knowles' family has farmed at East Barron on the Atherton Tableland since 1938. Bill took over the farm and dairy in 2000 but, with dairy deregulation and the drop in milk prices, gave up milking cows and now runs a beef feedlot and cropping enterprise.

From dairy to feedlot

The change over from dairying to beef feedlotting was not too expensive as most of the infrastructure and equipment needed was in place for the dairy operation. His feedlot has a 400 SCU AUS-MEAT grain-accredited licence and finishes about 1,300 head each year.

Bill owns 140 hectares, leases 100 from his parents and leases another 50 hectares. The red basalt soils can grow potatoes, maize for silage, grain, earlage winter cereal crops, lupins and tropical pasture seeds. He grows most of his feedlot ration needs (maize silage, grain, earlage, lupins and hay) on the property.

Finish during winter

With the economics of feedlotting very tough at present, cattle buy-in price is a critical factor in staying profitable. Bill will buy cattle any time if the price is right. However, most are purchased from May to July and sold finished from August to December. This means he is buying when there are plenty of stores on the market in North Queensland and selling when finished cattle are getting scarce. Consequently the feedlot operates only for 7 months during the northern dry season.

Background from 350kg to 420kg

The ideal animals for purchase are milk- and 2-tooth over 350kg live weight. Cattle being fed for the Japanese Ox market are backgrounded on improved pastures and fed a silage ration to get them up to 420kg for feetlot entry. This also allows different mobs of cattle to sort out their social order before they are penned.

Bill Knowles sorts his cattle before the feedlot.

HGP prevents too much fat in Brahmans

Cattle are implanted with Synovex Plus, a feedlot-specific HGP with 28mg oestradiol benzoate and 200mg TBA. This HGP is important for his Brahman cattle as he targets the 100-day Japanese market. The use of the HGP prevents them getting too fat before their time on feed is finished. Cross-bred cattle with low European content also get the HGP implant but not those with high European content.

Long haul to meatworks

Cattle are marketed 70-day or 100-day grain-accredited to Swifts Townsville or Teys Rockhampton—wherever the money is best. Bill is MSA registered but often only 30% of his cattle are accepted for an MSA premium. Others are not graded because of a combination of HGP use, hump height and non-compliance due to the time in transit.

Bill says that past research has shown that HGPs give extra weight gain per day and, in the feedlot business, he needs to maximise daily weight gain and feed conversion to stay in business. He has not seen any health problems in his feedlot with the use of HGPs.

Backgrounding on buffel with HGP

Lauchie and Carlie Ward run 'Namgooyah', a 4,800 hectare grazing property about 50km north of Dingo on the Fitzory Development Road in Central Queensland.

Buffel grass country

Most of their country has cracking clay soils; the brigalow was pulled 20 years ago and now carries buffel grass. Paddocks blade-ploughed and renovated over the last 7 years also have some green panic. The buffel pastures can carry about one beast of 400–450kg on about 3 hectares after a wet season spell or one on 4 hectares if not spelled. Over the last seven years, rainfall has averaged only 525mm—about 120mm less than the historical average.

Senepol breed

Namgooyah Grazing (trading name) is a family-run business. Beside the commercial beef production, they run seedstock and embryo transfer businesses for Senepol and Senepol–Charolais cross cattle. The Senepol is a stabilised *Bos taurus* composite between the N'dama from Senegal and the Red Poll, and it is earlier maturing than the Brahman. The commercial beef business is in a transition period that has seen them gradually changing from breeding towards trading and backgrounding.

An implanted Senepol x Brahman steer on buffel grass

Backgrounding

Lauchie and Carlie now sell feeder steers to the feedlot; these are 0 to 2-tooth (18–20 months of age) weighing 430–520kg. Any steers too heavy for the feedlot are fattened on pasture to Japanese Ox.

Having no emotional attachment to the genetics of the bought cows made it simple to appreciate the costs associated with running a breeder enterprise. With their business debt, they are focusing on profit and need to change to a system that pays them for every kilogram they put on their cattle because they have the right type of country to produce well.

HGP feeder or MSA finished?

When looking at the pathway to kilogram gain, they had to weigh up the options when it came to HGPs—better weight gain versus the penalty at slaughter in the MSA system. Under advice from one of the feedlots they had been supplying, they ended up implanting their male calves with a 400-day HGP in the cradle using Compudose 400.

So far, this has worked well. They have established a floor price that they can accept from the feedlots that would mean they still come out in front of the alternative, which is the grassfed bullock. So far, feeder prices have not gone below this price. If prices drop, and they have to hold their steers to finish them on grass, the system would face the penalties of the MSA system. Then they may have to revisit their options.

Visual benefit

Although they have never carried out a proper trial on the use of HGPs, they did have two peer groups running in similar conditions—one with HGP, one without. The group not implanted belonged to Carlie's father and definitely had the superior genetics that traditionally perform well year in-year out; the other group was of their calves out of bought cows and certainly not in the same genetic field. Lauchie's visual assessment was that the HGP-group outperformed the untreated group; they looked more forward and the weights from the feedlot suggested that the HGP had eliminated the genetic difference between the mobs. Generally their own cattle with HGP had similar, if not better, weights.

Eating quality premiums versus HGP weight gain

Ian McCamley's aim is to produce the tastiest grassfed beef and to get the best returns for doing so. He wants top MSA or EU premiums and this means that he no longer uses HGPs.

Ian and Kate McCamley of MCC Pastoral Pty Ltd fatten about 7,500 steers on 25,000 hectares of brigalow scrub over four properties north of Rolleston in Central Queensland. They turn off 3,000–4,000 head each year.

Ian buys in HGP-free young steers at approximately 250kg; he takes most breeds and cross breeds, but he prefers some *Bos indicus* content. The young steers are grown out and then finished to 600kg on buffel grass pastures. Steers average 220kg per head for the year (0.6kg/head/day); the gain over summer–autumn is about 0.9kg/head/day but drops to 0.3kg/head/day over winter–spring. The lighter cattle run at a beast to about 2 ha whilst heavier, finishing cattle run at a beast to about 3.2ha.

Grassfed beef can attract good premiums with no HGPs.

The finished steers go for MSA grading or for the EU market, with two third going MSA, one third for the EU market. After decades of implanting HGPs, Ian and Kate have made the decision to stop using them. This was firstly because their two newly EU-accredited properties obviously could not use HGPs but also on the other properties—after a fair bit of research and soul searching.

From an economic viewpoint, Ian found the following. His analysis of HGP trial data showed that only about half of the additional weight gain in HGP-implanted cattle came from better feed conversion; the rest of the gain came from increased feed intake—which he considers is not free.

He was also finding that a significant number their own implanted steers had carcase weights in excess of 340kg before they had the required minimum fat cover to grade. Once a carcase is over 340kg, it is no longer eligible for the trade premium or the MSA premium as most processor specifications cut off at this weight. This results in a drop of 20–30c/kg dressed weight; a 335kg MSA or trade carcase often returned a higher price than a 360kg carcase.

Ian worked out if their cattle had the required fat cover at a lighter weight, they would be worth more money and cost less to run. After analysing MSA trial data in relation to the HGP effect and through looking at their own grading results, Ian found that very few Brahman (high hump) HGP-implanted cattle would grade in the better boning groups that processors pay the MSA premium on. He also found that their HGP-free cattle were averaging a full four boning groups better than the implanted cattle. Finally, from an emotional viewpoint, having found that HGPs lowered meat eating quality by so much, Ian decided that satisfied consumers were more important than extra weight.

Ian says, "It really comes down to your target market. It makes economic sense for someone who sells cattle for the USA grinding beef market to use HGPs. For us chasing MSA premiums, we have made the decision to drop HGP use and forego some weight gain in favour of a higher price per kg for better eating quality beef."

HGPs in the large-scale feedlot

The Grassdale feedlot south of Dalby on the Darling Downs finishes more than 100,000 head each year, and most of these are implanted with an HGP. Mort & Co Lot Feeders Pty Ltd's operations include Grassdale with a current capacity of 35,000 head, and Gunnee at Delungra in New South Wales and Pinegrove near Millmerran, each with 7,000 head.

The Grassdale property has 2,000 hectares of prime cultivation land and 2,800 hectares of rough grazing country. Water comes from a sub-artesian bore with a back-up supply of waste water from coal-seam gas extraction. Coal seam water and bore water are mixed to supply the cattle pens, while the coal-seam water is used in the feed mill to generate steam for flaking grain.

British or cross-bred cattle

Cattle are sourced from anywhere in eastern Australia—from Victoria to Cloncurry. Each week, Grassdale receives 2,500 head of British or cross-bred cattle aged 12 to 24 months; some are backgrounded on the rough native pasture land while being fed a starter ration.

The markets

The markets for finished cattle depend on the demand.

At present, few are shortfed for domestic veal (40–60 day) or domestic trade steers or heifers at 70-80 days. The main supply is for Japan Ox fed for 100 days with cattle entering at 400–460kg and going at 640kg. Most of these are are implanted with HGPs. Some are mid-fed for 150 days for niche domestic markets.

British cattle for Japan Ox market

A number of Wagyu are longfed for 360–420 days; these enter at 270–360kg and are turned off at 660kg. The early-maturing Wagyu are not treated with HPGs, but are sold to a special market rewarding intramuscular marbling score.

Desire for marbling means no HGP for longfed Wagyu.

Induction

At induction, all animals are weighed and tagged, mouthed for dentition, given a nasal inoculation of Rhinogard against BRD and treated against internal and external parasites.

Cattle are checked for previous HGP implantation on the NVD (National Vendor Declaration).

Checking dentition at induction

Implanting HGPs

At induction, animals for the Japanese Ox market are implanted with Progro (200 mg TBA + 20 mg oestradiol) with the pellet having a palpable marker (ball bearing).

Implanting HGP for fast gains and good feed conversion efficiency.

Animals may receive a 'soft' implant of 8 pellets as Progro S or H or a 'hard' implant of Progro TE-H with 10 pellets.

The life of the soft implant is 40–60 days; steers get Progro S and, if being fed for 150 days, may receive a second implant. While this second implant might well provide an extra boost, there is a major logistical problem with handling the current load of 35,000 head in addition to the new receivals of 2,500 head each week.

500–600 tonnes fed out every day

The normal feedlot fattening ration is based on sorghum–wheat or sorghum–maize with cotton seed and forage sorghum silage. The feed mill has three steam-flakers, and is currently feeding out 500–600 tonnes of finished feed each day. All cattle are fed at the same time each day to increase efficiency, consistency and performance.

Gains of 1.8–2.4kg/day

HGPs are used to achieve weight gains of 1.8–2.4kg/day and a feed conversion efficiency to 6–7kg feed/kg weight gain 'as fed'.

The strategy is for a heavier carcase rather than younger turn-off as the heavier carcase returns an extra $220–230/head. Finished cattle are marketed to all the major abattoirs.

Overall, there are few problems with implanting HGPs but sometimes they can result in bulling and prolapse of the pizzle, especially in cattle with excessive sheath. Steers seem to be more susceptible if they have not been previously implanted.

These Droughtmaster steers get fed right on time each day.

Appendix 1. Formulations of HGP products registered for use in Australia (2009)

Product name	Hormone formulation (per implant)	Implant type	Carrier matrix*	Label statement for use
Compudose 100	21.1 mg oestradiol-17ß	silicone rubber	silicone rubber	Increased weight gain in pastoral steers including suckling steers and in spayed heifers and vealer calves. Improved feed efficiency and increased weight gain in lot-fed steers and spayed heifers.
Compudose 200	25.7 mg oestradiol-17ß	silicone rubber	silicone rubber	Same as for Compudose 100
Compudose 400	43.9 mg oestradiol-17ß	silicone rubber	silicone rubber	Same as for Compudose 100
Compudose – G	60 mg TBA 12 mg oestradiol-17ß	compressed pellet	cholesterol	Improved growth promotion in pasture-fed steers and heifers
Compudose – G with tylan	60 mg TBA 12 mg oestradiol-17ß 29 mg tylosin tartrate	compressed pellet	cholesterol	Same as for Compudose–G
Progro H	200 mg testosterone propionate 20 mg oestradiol benzoate	compressed pellet	lactose	Improved weight gain in heifers
Progro S	20 mg oestradiol benzoate 200 mg progesterone	compressed pellet	lactose	Improved weight gain in steers
Progro TE-H	200 mg TBA 20 mg oestradiol-17ß	compressed pellet	lactose	Improved growth promotion and finishing of heifers
Progro TE-S	140 mg TBA 28 mg oestradiol-17ß	compressed pellet	lactose	Increased weight gain and improved feed efficiency in steers
Progro T-S	140mg TBA	compressed pellet	lactose	Same as for Progro TE-S
Ralgro	36 mg zeranol	compressed pellet	lactose/boric acid	Increased rate of growth and improved efficiency of feed utilisation in steer cattle
Revalor – G	60 mg TBA 12 mg oestradiol-17ß	compressed pellet	cholesterol	Improved growth promotion in grassfed heifers and steers
Revalor –H	200 mg TBA 20 mg oestradiol-17ß	compressed pellet	cholesterol	Improved growth promotion and finishing of heifers and steers
Revalor – I	80 mg TBA 16 mg oestradiol-17ß	compressed pellet	cholesterol	Improved growth promotion in non-breeding cattle
Revalor – S	140 mg TBA 28 mg oestradiol-17ß	compressed pellet	cholesterol	Improved growth promotion and finishing of steers
Synovex C	10 mg oestradiol benzoate 100 mg progesterone	compressed pellet	polyethylene glycol	Improved weight gain in heifer and steer calves
Synovex H	200 mg testosterone propionate 20 mg oestradiol benzoate	compressed pellet	polyethylene glycol	Improved weight gain of heifers
Synovex S	20 mg oestradiol benzoate 200 mg progesterone	compressed pellet	polyethylene glycol	Improved weight gain of steers
Synovex with TBA = Synovex Plus	200 mg TBA 28 mg oestradiol benzoate	compressed pellet	polyethylene glycol	Improved weight gain and feed conversion efficiency in steers and heifers under feedlot conditions

*The precise formulation of implants is ‘commercial-in-confidence’ to the manufacturing companies.
TBA = trenbolone acetate
No registered products have a withholding period