Economic Analysis of the Usage of Recombinant Bovine Somatotropin on the Dairy Farm

Costs related to adverse health risks resulting from rBST use may equal or exceed the financial benefits relating to increased milk yield

Tag Words: Recombinant bovine somatotropin; rBST; Recombinant bovine growth Hormone; rBGH

Authors: Adam Mazin, Emilie Whitacre, Paulina Ruszala with Julie M. Fagan Ph. D

Summary

Recombinant Bovine Somatotropin has been widely used in America since its release in 1994. A lactating cow that is injected with rBST produces ten to fifteen percent more milk compared a lactating cow that is not injected with the hormone. Although there is a observable increase in milk yield there is also an increased chance of the cow developing mastitis, lameness and reproductive issues. The increase of complications costs the producer more money in the end; therefore having a herd on rBST may not be economical. The purpose of our project is to create public awareness on the issue of rBST and to analyse and compare the cost effects of a rBST farm to a non-rBST farm. Our economical analysis found that non-rBST farms could make more money compared to a farm that uses rBST. At certain percentages of yield and disease our findings show that the profit made from a 10% increase milk yield from the use if rBST does not compensate for the amount of money that lost due to its implications. The loss of profit results from treating cows for mastitis increased feed costs and the loss of production cows due to laminitis and/or poor reproduction rates.

Video Link: http://youtu.be/27g1be5eKTc

Complications of rBST Use in Cattle (AM)

rBST causes a variety of problems in dairy cattle. These issues include an increase in the risk of mastitis, lameness, and a decrease in fertility. The company who creates rBST, Monsanto acknowledges Prosilac (branded rBST) as a cause for “adverse reproductive effects, clinical
mastitis, foot and leg problems, injection site reactions, udder edema, and other general health effects.”

Mastitis is an inflammation of breast tissues which is caused by a few bacteria. This includes *S. aureus*, *S. epidermidis*, and *streptococci* (1). There are multiple types of mastitis though the one plaguing rBST-treated bovine is puerperal which is linked with lactation. The bacteria grow when there are blocked milk ducts or excess milk in production (1). The livestock suffering from mastitis are affected by udder tenderness, malaise, swelling, burning sensation, fever, and deformation of the affected udder. Mastitis incidence is shown to increase in rBST treated cows. There are two categories mastitis falls into, clinical mastitis and subclinical mastitis (3). Clinical mastitis is when the cows physiological and anatomical condition shows recognizable signs and symptoms of the disease. Subclinical mastitis is when the disease is not severe enough to present definite or readily observable symptoms. Subclinical mastitis was measured by somatic cell counts and the prevalence of intramammary infections (3). This was measured in the milk produced by the rBST-treated and untreated cows.

rBST-treated and untreated cows were tested prior to the treatment period to make sure one group wasn’t more vulnerable to the suspected ailments more than the other. Recombinant bovine somatotropin was found to increase the risk of clinical mastitis by approximately 25% (3). 78% of the overall clinical mastitis cases took place during the treatment period indicating that rBST is in fact the culprit (3). It is believed that rBST indirectly increases the risk of mastitis through increased milk production. According to Dohoo treating cows with rBST would cause an 19.4% increase in total mastitis cases (3). Subclinical mastitis had a slight increase in cows treated with rBST. The risk ratio was 1.06 (5).

There is also a reproductive risk present in rBST-treated cows. Fertility and calving is of great importance to farmers as it is a great determinant in future wealth. A lot of money and care goes into guaranteeing the birth of a healthy calf and rBST can take away from both the farmers resources and the welfare of the animal. When looking at reproduction the following categories are measured: cystic ovaries, services per conception, calving to conception interval, incidence of twinning, and overall risk of a cow not becoming pregnant.

The risk of cystic ovaries was proven to increase by 25% (3). Ovarian cysts are sacks of fluid that grow inside ovaries. Normally they are benign, however they can become cancerous. Cysts that undergo rampant growth can cause a plethora of ailments to the affected animal. Ovarian cysts can cause pain, soreness, and infertility, which is of concern to the owner. Ovaries may have to be removed which eliminates the possibility of future breeding.

Twinning also varied with the use of rBST. Primiparous cows were shown to have an increased risk ratio of 7.1 for twinning while multiparous cows had an increased risk ratio of 11.7 (3). The
risk of twinning is that it increases the nutritional requirements upon the cow. It is much harder for the cow to maintain healthy weight and birth the calves successfully without a miscarriage or complications. Fortunately there was no effect on services per conception. There was a 40% increased risk of a cow failing to conceive. Abortions were seen to increase in frequency (3). Risk ratios of 1.2 and 1.11 can be seen for primiparous and multiparous cows respectively (3). rBST can be seen to diminish the chance of pregnancies as well as their chance of success.

An increased risk of lameness is also evident with the use of rBST. Lameness is a term used to describe a number of maladies in the animal. Lameness can be represented by laminitis, broken bones, torn muscles, neurological disorders, and hoof infections or malformations. Laminitis is an inflammatory disease of the hoof. One study showed an approximately 50% increase in laminitis (3). Lesions were seen on the hock, fetlock, and hoof. These issues can cause an otherwise healthy animal to refuse to move in order to feed or for maintenance and opens the doorway for more serious infections.

Injection sites for rBST frequently had negative reactions. The reactions were judged on a scale from 0-3 with the higher numbers representing more severe reactions. 60% of the reactions scored between 2-3 while there were few more serious reactions seen (3).

Culling also increased with rBST. Culling is the removal of a cow from the herd and was primarily seen in multiparous cows (5). It was seen to increase by 20-25%. (3). Older cows were much more likely to undergo culling as well. The risk ratio for culling was 1.38 for multiparous cows (5).

Discovery of rBST and its History
(EW)
The effects of somatotropin on growth and lactation was first expressed when lab animals were injected with pituitary extract in the early twentieth century. By the 1940s, it was established by Azimov and Krouze that it was indeed somatotropin that increased both milk yield and growth in laboratory animals, but it wasn’t until the 1950s that the effects of bovine somatotropin were studied long term in lactating dairy cows and was shown to increase milk production by fifty percent. Biotechnological breakthroughs in the 1970s allowed for the manipulation of bacteria so that they could synthesize bovine somatotropin, thus creating a recombinant bovine somatotropin, rBST (6). This was accomplished using recombinant DNA technology, cloning the gene for bovine somatotropin into Escherichia coli so that the bacteria would produce the protein in large quantities (7; 12). Finally in 1982, scientific studies were conducted and published examining the effects of rBST on milk production (6).

Recombinant BST increases the lactation of dairy cows by about 12% in two ways: first by increasing the volume of milk produced and second by increasing the length of time during
which the cow lactates (6). It is introduced into the animals’ system not by consumption but by injection because the protein hormone would be digested and degraded by the animal otherwise. The dosage required to cause an effect is merely 36mg, which is administered every two weeks by injection of 500mg of slow release hormone (6).

In 1993, rBST was approved for use by the FDA, and its widespread use began in 1994. Since then, over 56 countries as well as the World Health Organization, National Health Institution, and Food and Agricultural Organization of the United Nations have all found rBST to be not only safe for human consumption but also just as nutritious as milk from non-rBST cows. In spite of the number of safety approvals from worldwide organizations as well as numerous national organizations, there has been a growing concern for rBST’s effects on long-term human health. (11)

The European Union has formally introduced warnings as to the questionability of the safety of rBST milk for human consumption. Though rBST is a bovine species hormone and will not have somatotrophic effects on humans, it is feared that its metabolites will have an effect. rBST use in bovines is known to increase circulating levels of insulin-like growth factor-1 (IGF-1) which then becomes a constituent of the milk. However, there is no evidence to suggest that the concentration of IGF-1 in rBST milk is greater than in non-rBST milk. Additionally, the EU warns that rBST may evoke a change in constituent milk proteins which may trigger allergic reactions, but as rBST never enters the milk itself and only stimulates bovine somatotropin receptors, which then activates the same pathway that would be activated by endogenous hormone, this argument is invalid. (8; 9).

The most common and most credible drawback associated with the use of rBST is the increased incidence of mastitis. Among the rBST treated lactating dairy cows, there is an incidence of approximately “one additional case per 10 lactations” and over time “[could] be approximately half that expected with a corresponding seven years of genetic and herd management related production improvements” (10). EW

Factors That Increase Milk Yield
(PR)

With population growth rapidly increasing it is vital our food production is able to meet this demand. In regards to milk production over the last century dairy cows have produced a four-fold increase in milk yield and a three-fold increase in productive efficiency (13). When evaluating the increase of milk production it is important to consider all the contributing factors, not just the use of rBST. Although rBST is scientifically shown to increase milk yield there are many other factors that should be noted as well. Two major components that caused the increase in milk yield over the past century include selective breeding and management factors. Many
factors go into keeping a cow in production. Typically the healthy cows are those who are selected to breed in order to produce equal or improved offspring. Positive characteristics that are selected in breeding include milk yield, fat/protein ratio, health, confirmation and fertility. Reproductive management is another factor that also aids in the increase of our nations world food supply. Management factors include feed and water supply, growth hormones, milking intervals, milking frequency, milking secretion rate and the amount of residual milk that is left after milking (14).

Increase milk yield reflects the advancement of research and technology in the dairy industry. Therefore when approaching the controversial topic of the use of rBST in the dairy industry it is important to consider and evaluate all the contributing factors. One must look at if possible complications of rBST outweigh the increase milk production caused by the administration of rBST.

rBST and Milk Yield

(PR) It has been scientifically proven that there is a positive correlation between the use of rBST and milk yield. It is estimated that the use of rBST creates a ten percent to twenty percent increase in milk production. One study conducted by Judith L. Capper and associates showed that rBST improved the efficiency of milk production. The study found that the use of rBST allows the cow to utilize its energy more efficiently. The research also argues that the use of rBST reduces carbon dioxide emission, which is considered to be a green house gas. Conventional farms that use rBST can produce the same amount of milk as conventional non-rBST farms with 8% fewer cows (13). Also, organic farms need 25% more cows in order to meet the same demand. The literature argues that increased milk yield allows farmers to have fewer cows, which leads to a lighter impact on the environment.

Although studies have confirmed a positive correlation between milk yield and rBST use, they fail to recognize the implication that the hormone has on the physiology of the cow. As stated earlier, studies have shown that the use of rBST does negatively affect the physiology of the cow, which causes economic loss. The use of rBST is correlated with an increase in mastitis, lameness and reproductive issues. Greater incidences of mastitis cause the need for antibiotics, which cost farmers 1.2-1.7 billion dollars annually (15). The greater use of antibiotics also contributes to antibiotic resistance, which is a great global concern. Also, when a cow is being treated for mastitis, she must be withheld from being milked into the milk tank for a certain number of days, which is another loss of production. Lameness and loss of fertility are other factors that are not mentioned when making an argument for the use of rBST. Cows that are lame and that loose fertility are typically culled because they cannot meet the demands of milk production. When analyzing the cost benefits of increased milk production due to growth
hormones it is important incorporate money lost due to the implications of rBST.

Public Awareness on rBST and Current Solutions to the Issue

Many people are opposed to the use of synthetic growth hormones within the dairy industry due to a public stigma over the past decade. Even though people are against the use of rBST they are unaware of what it really is. One of the main reasons why the general public has a negative outlook on rBST is due to labeling. Certain companies and restaurants are making claims that they provide dairy products that are free from rBST. One example of this is a major Mexican restaurant chain by the name of Chipotle, which claims that they use meat and dairy that is free from growth hormones. In 2009 Yoplait and Dannon announced that they would no longer purchase milk from cows treated with rBST (16). Starbucks, a popular café is another company that is pledging to use milk from rBST free cows (17). Labeling dairy products this way creates a perception that food that is free from rBST must be better. This technique has drastically decreased the popularity of dairy items with rBST, but at the same time it is very misleading to the public because it does not give people the proper information about the hormone. If people are not educated about the hormone then they cannot make an informative decision whether to stop the consumption of milk from cows treated with rBST or not.

When rBST first came out in 1994 the FDA did not find any difference between the milk from cows treated with rBST compared to milk from cows where rBST was not used. Therefore the FDA does not require the labeling of milk from cows treated with rBST. This created a problem because farmers who were opposed to the use of the hormone from the start wanted to be able to separate their product as “rBST free”(18). The FDA guidelines left it up to the states to set their own restrictions on labeling as long as the labeling was not misleading to the public. Labeling a dairy product “rBST free” would be misleading because all milk contains some form of BST naturally (18). The FDA also recommended including a disclaimer that stated, “No significant difference has been shown between milk derived from rbST-treated and non-rbST-treated cows”(19).

One of the major issues to this solution of banning products derived from rBST treated cows is that it is very confusing and misleading to the general public. Since all 50 states have different regulations on labeling milk derived from non-rBST-treated cows it is easy to see one states outlook on the hormone can be very different from another states outlook. Another issue is selling rBST free products across state lines (20). Issues arise if a company legally labels its product rBST free and wants to sell its product to a state that prohibits labeling. The company is faced with two decisions. One is to remove the labels and the other is to not sell its products to states that prohibit labeling. These two situations cause a loss of profit.
Although labeling has greatly contributed to the decrease use of rBST, it does create some additional problems. With labeling the general public can be misled and confused. Labeling also does not inform the public on facts about rBST therefor the public is unable to make informed decisions on their consumption of milk derived from rBST treated cows. Labeling regulations also impose complication in exporting and importing dairy products between state lines. Our group has proposed a new approach to the solution that will educate the public on the implications and negative affects of rBST.

Educating the Public on rBST and its Economical Impact

(PR/EW/AM) The issue of rBST in the dairy industry has been an ongoing controversy for over a decade. Today, a fraction of the general public holds a negative outlook on rBST. This stigma has been greatly influenced though the labeling and the advertisements of dairy products. Even though the public’s negative outlook on rBST has pressured farmers and companies to sell dairy products from cows that are not treated with rBST, the public is still not making there own educated decisions. If people truly understand the scientific aspect of rBST and the implications that it causes on animals and humans they will be able to make an informed decision to not consume milk that is derived from cows that are treated with rBST. This would then put enough pressure on farmers to completely eradicate rBST from our nations herds.

In addition to targeting the consumer our project will also target the producer. The decision to use rBST starts with the dairy herd farmers. Typically, larger dairy farms are more likely to use rBST compared to smaller dairy farms. To target the producers we will incorporate an economical analysis of the use of rBST in our paper. We will compare the profits of a farm that uses rBST to a farm that does not use rBST. As stated earlier, a cow that is on rBST produces ten to twenty percent more milk. This demand to produce more milk increases the chance of the cow developing mastitis, lameness and reproductive issues. These factors can greatly dampen the ten to twenty percent increase in profit due to milk yield.

For the economical analysis our group will calculate the average amount of money that is made from the ten to twenty percent increase in milk production on an rBST farm. We will then calculate the money that is lost from the treatment of cattle caused by the complications of rBST. When a cow gets mastitis she must be treated with antibiotics and if there is an increased incidence of mastitis then the antibiotic cost can add up quick. Also, if a cow is lame she may need to be culled if she is unable to walk or stand. Culling cows due to lameness is another economical loss. The dairy industry heavily depends on the ability of their cows to produce offspring. If cows are unable to get pregnant and produce calves then the she will not produce milk and replacement calves.

Our paper will be submitted to a newspaper or magazine in hopes of getting published. Since our paper is targeted to the general public and to dairy producers we will choose a newspaper or magazine that is available to both groups.
Economical Analysis

Table 1: Economic analysis

<table>
<thead>
<tr>
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<th>Farm A- rBST</th>
<th>Farm B- No rBST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle Count</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Profit from milk sales</td>
<td>$335,610</td>
<td>$297,000</td>
</tr>
<tr>
<td>Feed Costs</td>
<td>-$124,300</td>
<td>-$106,480</td>
</tr>
<tr>
<td>Cost of rBST</td>
<td>-$11,880</td>
<td>0</td>
</tr>
<tr>
<td>Loss from decrease in milk</td>
<td>-$6,700</td>
<td>0</td>
</tr>
<tr>
<td>Loss from decreased milk quality</td>
<td>-$5,500</td>
<td>0</td>
</tr>
<tr>
<td>Loss from mastitis treatment</td>
<td>-$3,060</td>
<td>0</td>
</tr>
<tr>
<td>Loss due to involuntary culling</td>
<td>-$3,900</td>
<td>0</td>
</tr>
<tr>
<td>Total Profits</td>
<td>$180,270</td>
<td>$190,520</td>
</tr>
</tbody>
</table>

Our group used a hypothetical situation and compared the total profits of two dairy farms, each consisting of 100 cattle. We used a milk market price of $13.50/100lbs (21). Farm A is a farm that uses rBST resulting in a 13% increase in milk yield. Farm A also observes an increased feed cost because cows that are on rBST have increased feed intake. The farm also observes a 20% increase in mastitis, which is another loss of profit, because the cows must be treated with antibiotics (23). Farms that have cows on rBST also lose money due to the loss of milk quality. Laminitis and reproductive issues also increase. These factors lead to an increased rate of involuntary culling (23). The actual drug costs about $11,880 for a 100 head of cattle which is another added cost (22). Farm B is a farm that does not use rBST and does not have any of the additional costs compared seen in Farm A because they do not have to deal with the amount of complications from rBST. For our service project this economical analysis will be shown in order to help change the minds of consumers and producers.

Resources


**Letter to the Editor:**

Paulina Ruszala- Submitted to the East Brunswick Home News

Dear Editor,

It is a sad truth that many Americans are unaware of how their food is being produced and processed. Many know that there is a negative stigma attached to the use of recombinant bovine somatotropin (rBST) but do not have the slightest clue of what it actually is. Bovine somatotropin is a hormone that is naturally produced by the pituitary gland. Recombinant bovine somatotropin is an artificial form of the hormone that is synthesized through recombinant DNA technology. This hormone is injected into cows during the later stage of lactation in order to increase milk yield. It has been scientifically shown that rBST does increase milk yields about ten to twenty percent, but it also increases the chance of complications in the lactating dairy cow. Cows that are injected with rBST have an increased chance of developing mastitis. They are also more likely to have reproductive issues and lameness. Even though rBST does increase milk yield there are certain complications that end up costing the producer more money. This is an important factor to consider when educating the producers and consumer on rBST.

Although this hormone has been widely used for many years since its release, it is slowly becoming less popular amongst dairy producers because many consumers are demanding rBST free dairy products. Many businesses use the general public’s negative view on rBST as marketing strategy to increase their sales. The general public believes that dairy products from rBST free cows are of better quality and healthier but do not have any information to support their beliefs. It is important to give consumers and producers the proper information on rBST and its economical analysis so they can make better-informed choices, hopefully to the point that rBST will no longer be used.

Sincerely,

Paulina Ruszala

Emilie Whitacre - Submitted to Good Housekeeping Magazine
To the Editor,

Dairy products in American supermarkets are the subjects of an intense debate: is the milk of cows treated with recombinant bovine somatotropin (rBST) safe for human consumption? Countless studies around the world have yet to provide substantial evidence that rBST has any effect in humans, but there have been a number of studies that have shown the adverse effects of this hormone on the dairy cow. Treatment with rBST causes dairy cattle to lactate for a longer period of time and to produce more milk than an untreated animal. The increased demand on the animal’s body causes an infection called mastitis, which is not only painful for the animal, but also required that the animal be removed from the production line and treated with antibiotics.

Aside from being an ethical issue, an interesting point is made when one thinks about the logic behind this hormone’s use; is the use of rBST really increasing profit for dairy farmers? Farmers assume they are making more money because they are producing more product to sell from the same number of individuals, but with increased incidence of disease and therefore treatment, do the costs of treatment cancel out sales profit? The debate surrounding rBST use in American dairy cattle consists of many levels including human health, animal health, ethical issues, technology use, and now economical issues. It will be quite some time before enough reliable research is conducted to form a educated and scientific conclusion about the use of rBST in dairy cows.

Sincerely,

Emilie Whitacre

Adam Mazin- Submitted to New York Times

Dear Editor,

Recominant Bovine Somatotropin is causing a lot of controversy in the agriculture industry recently. Farmers praise its ability to increase milk output and relieve some of the financial hardship on a farm while others oppose rBST on the basis that the cows suffer with its use. rBST is produced by Monsanto under the name Prosilac and is legally allowed to be distributed and used in the USA. In most European countries, Prosilac has been banned which is a practice we should follow.

The use of rBST causes many health concerns in bovines. The biggest issue is the increase in severity and frequency of clinical mastitis, which is an inflammation, and infection of the cows’ udder. Secondary but by no means less serious is the increase in lameness, decrease in fertility, and increase in culling. The use of rBST could negatively impact the profit the farm is making if antibiotics are necessary to treat the laminitis cases. Additionally feed intake increases with the usage of rBST to balance the increased milk output. Milk is more likely to go bad and have to be disposed of as well. If one looks at the big picture, rBST can be seen to have minimal benefits compared to costs.

I’m writing to you to educate the greater public of the issues of rBST and to spread the financial analysis my classmates and I have written. We have compared two farms side by side: a farm that uses rBST and a farm that does not use rBST. Our analysis compared the extra
expenses and increased milk yield of rBST-treated cow farms and found out that the total profit is lower than that of a farm that uses organic cow husbandry techniques. To see our research, please go to https://docs.google.com/document/d/1tqme59-Wrpkm_Ev0-3r0llH5ohSabnLTTAILO7xAtnw/edit