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PRODUCTIVE AND HEMATOLOGICAL RESPONSES DUE TO INJECTION OF LONG ACTING SOMATOTROPIN IN FRIESIAN COWS.

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ABSTRACT

Fourteen lactating Friesian cows were used, 7 cows as control injected subcutaneously with saline (0.9% Nacl) and the rest were injected subcutaneously with 500 mg rbST (Somatech®) at injection intervals of 14 days.

Blood and milk samples were taken every two weeks for analysis. Milk constituents such as fat, total protein, lactose, total solids, solids not fat and somatic cell count were determined. Fresh blood used for the determination of hemoglobin (Hb) and hematocrit (HT). Blood constituents (total protein, albumin, globulin, total lipids, triglycerides and glucose were determined in plasma colorimetrically. Results are summarized as follow: Injection of rbST causes insignificant increase in both Ht (%) and Hb (g/dl) of the whole blood by 2.6% and 1.4%, respectively over the control. Hb concentration was higher in injected cows' plasma blood at 3rd, 4th, 7th and 10th injections. Concentrations of plasma total protein (g/dl), globulin, triglycerides (mg/dl) and the ratio between albumin and globulin were significantly ($P<0.05$) higher by 5.9 %, 13.1%, 11.1% and 3.8 %, respectively, while plasma albumin was lower in blood of rbST injected cows by 0.7%, than the control cows. Meanwhile, concentration of plasma total lipids (g/L) was slightly higher in blood of rbST injected cows than control by 0.5%. Total protein concentration was higher in treated cows at 1st, 2nd, 3rd, 5th, 6th and 7th injections.

Milk yield at 305 days was higher ($P<0.05$) in rbST treated cows than control by 20.6%. Injection of rbST in Friesian cows had significantly higher milk protein than control by 2.4%, it was significantly higher at 1st, 2nd, 3rd, 4th, 5th, 7th, 8th, 9th and 10th injections. Cows injected with rbST were insignificantly higher in milk fat and total solids, but lower in milk lactose than control cows by 11.1 %, 9.4 % and 0.2%, respectively. Changes in milk somatic cell count revealed that control cows had lower ($P<0.05$) counts than rbST treated cows by 30.6 %.

Keyword: rbST, Friesian cows, blood, milk, somatic cell count

INTRODUCTION

The long acting rbST of Eli Lilly (USA) was used in this experiment (Somatech®). Previous numerous researches were done to study its effects on milk production and its constituents Bauman, (1992), Phipps, et al., (1997), and Tarazon, et al., (2000). Somatotropin is a key control in the regulation of nutrients used during lactation Bauman and Currie, (1980) and Hart, (1983).

Supplementation of rbST not only causes an increase in milk production, but also increases persistency of milk production. Several researches had demonstrated little increases in milk yield and milk

constituents when treatments were done during environmental heat stress Mollet, *et al.*, (1986) and Zoa-Mboe, *et al.*, (1989).

Recombinant bovine somatotropin (rbST) is a homeorrhetic controller, that had been successfully used to improve the productive performance without any adverse effects Eppard et al., (1987); Bauman, (1992) and Peel and Bauman, (1987).

The objectives of this research were : to study the effects of rbST on some physiological responses. Also, its effect on the productive performance and somatic cell counts in milk of Friesian cows reared under the Egyptian conditions.

MATERIALS AND METHODS

Fourteen lactating Friesian cows were used, 7 cows as control were injected subcutaneously with 10 ml sterilized physiological saline (0.9 %) and the rest (7 cows) were injected subcutaneously with 500 mg (Recombinant bovine somatotropin) rbST (Somatech®) . A total of 3 cows were primiparous and the rest (4 cows) were multiparous (2-4 parities) in each group. Injections were at 14 days intervals, it started at the 6th week postpartum and continued for 5 months during lactation.

Animals were housed in semi-shaded open yards. Feeding requirements of experimental lactating dairy cows were calculated according to N.R.C (1989).

Milk yield of both morning and evening milkings were collected biweekly and a composite milk sample was taken. Milk constituents such as fat, total protein, lactose, total solids and solids not fat were determined immediately after milking, using Milkoscan analyzer®. -130 B,N. Foss Electric, Denmark. Somatic cell counts were also determined immediately after milking using Somatic®, Bentley Instruments Inc., Minnesota, USA.

Blood samples were collected biweekly from the jugular vein in heparenized vacutainer tubes. Hemoglobin and hematocrit values were measured using fresh blood samples. Then blood was centrifuged to separate plasma which stored at –20°C until analysis. Blood constituents (total protein, total lipids, albumin, globulin, triglycerides, glucose) were determined colorimetrically.

Data were subjected to analysis of variance as repeated measurements (Split plot in time) according to Neter et al., (1985) using the GLM of SAS (1998).

RESULTS AND DISCUSSION

1-Blood constituents

1.1. Effect of rbst injection on blood constituents:

During all the experimental period, injection of rbST caused significant ($P<0.05$) increases in some blood constituents such as total protein, globulin, albumin/globulin ratio, glucose and triglycerides concentrations by 5.9 %, 13.1 %, 3.8 %, 5.6 % and 11.1 %, respectively (Table 1). But it's effects were non significant on the other constituents.

In this respect, Gallo, et al., (1989) reported that injection of 350 mg of rbST every 14d, did not affected hemoglobin (g/dl) and hematocrit (%) concentrations in Holstein cows. The values of Hb (g/dl) were 10.7 and 11.27, and the values of Ht (%) were 27.5 and 28.9% in control cows and rbST treated cows, respectively. In the contrary, Zoa-Mboe, et al., (1989) found that the values of hematocrit (%) decreased significantly in rbST treated cows than control. And the values of albumin/globulin ratio did not change in control and rbST treated cows, Eppard, *et al.*, (1987).

The higher triglycerides is inaccordance with the results of Gallo and Block (1990b) which reflect that rbST favorably enhances lipolysis in rbST created lactating cows which in turn increase its pool in blood and its availability to the mammary gland which in turn will help in lactogenesis and lactopoiesis. Also, West, *et al.*, (1991) found that rbST injection did not affect significanly the concentrations of total protein and albumin but triglycerides in serum was higher in cows receiving rbST by 89 % than control. In the same trend, Soderholm, *et al.*, (1988) showed that albumin, glucose and serum triglycrides were not affected ($P<0.05$) by rbST treatment, however the hematocrit was affected ($P<0.05$) by rbST injection

1.2. Changes in blood constituents throughout the period of rbST injection.

The present results shows that the sequence of rbST injection did not significantly affect the concentration of total protein, albumin, globulin, albumin/globulin ratio, glucose, total lipids triglycerides. While, it was only significantly ($P<0.001$) affect the Ht and Hb values in blood of lactating Friesian cows.

The changes in Ht (%) in blood during the experimental period showed a significant effect of rbST, it caused an increase till the 5th injection, then it decreased than control. While the variation in Hb value did not show any specific trend (Fig.1 &2). In this respect, Burton, et al. (1990) reported that daily injection of rbST at dosages of 10.3, 20.6 and 41.2 mg/d in Holstein cows caused a non significant reduction in hematocrit (%), While, in the case of Hb value (g/dl) were not differed than the control.

Values of plasma concentration of total protein (g/dl), albumin (g/dl), globulin (g/dl) and albumin/globulin ratio in injected and control cows are presented in Fig. (3, 4, 5 and 6). It could be noticed that, the total protein concentration was insignificantly higher than that in control cows in the most of injection times, (1st, 2nd, 3rd, 5th, 6th, 7th, 8th, and 9th). As it was recorded that, the total plasma proteins are synthesized in the liver Kaneko, (1989). Thus, the tendency for the differences in plasma total proteins between control and rbST treated cows indicated that the metabolic activity of the liver differed between them. From the present results, rbST may play a role in enhancing the metabolic activity of the liver.

Albumin concentration in injected cows was decreased gradually by sequences of injections, it was higher ($P<0.05$) in the first injection than the 8th, 9th and 10th injections, but along the injection period, it was non significantly changed than the control. Similarly, Eppard, et al., (1987) concluded that rbST injection did not change the concentration of plasma

albumin (g/dl) and globulin (g/dl). Gallo and Block (1990a) reported also that concentration of plasma proteins and albumin were not altered by rbST injection.

Variations in plasma glucose (mg/dl), total lipids (g/l) and triglycerids concentrations throughout the experimental period for both control and rbST treated cows are showed in (Fig. 7,8 and 9). The treated cows showed increases in these values than control. That is in agreement with the results of Eppard, *et al.* (1987) and Gallo and Block, (1990b).

These findings clarify the role of rbST as a lipolytic factor that favorable lipolysis in lactating cows and increase the levels of triglycerids in plasma pool, which lead to greater availability to the mammary gland. Thus, Soderholm, *et al.*, (1988) stated that serum triglycerids were not significantly affected by rbST injection. Gallo and Block, (1990a) reported that the percentage of triglycerides as a proportion of total lipids content increased ($P<0.05$) by rbST treatment.

2- Milk production

2.1. Milk yield.

The 305 days milk yield was higher ($P<0.05$) in rbST treated cows than control by 20.6% (4046.1 vs. 3353.1 kg/305 days, respectively). Table (2). Also, Figure (10) represented the changes in monthly milk yields in both control and rbST treated cows. It could be noticed that increasing the dose of rbST seemed to have more influence on milk yield during the first 5 months of treatment, However, the effect of rbST injection compared to the control was appeared immediately after the 1st injection (291.2 kg vs. 252.4 kg), respectively.

Peel and Bauman, (1987) stated that milk yield gradually increased after the first few days of rbST treatment (18%) reaching the maximum about the 6th day (40%). Maximum milk is achieved at rbST dose (daily injection) of about 30 to 40 mg/d. In the same trend, Tarazon *et al.*, (2000) stated that injection of 500 mg of rbst every 14 days increased milk yield by 24.4% over the control.

In the present study, the response in milk yield due to rbST injection is lower than some of the previous research done, such as Abdel-Nabi, (1992). The reason for that might be due to the poor management for the experimental cows and/or to the different feeding regimens.

Fig (10) shows the effect of rbST on milk production throughout the injection period till drying off which takes 3 phases: a gradual increase from 2nd to the peak at the 5th injection, then the persistency (maintaining the increase rate) after 5th until 9th injection, thenafter, a decline in the percent of the increase till the end of 9th injection.

From the previous data, it could be stated that the importance of treatment was achieved at the 5th rbST injection, the percent of milking increase gradually and decline thereafter till the 6th month of injection, which lead to recommend to stopping the injection.

2.2. Milk constituents.

Injection of rbST did not significantly affect the concentration of some milk constituents (fat, lactose, total solids and solids not fat). However, fat % was 11.1% higher; lactose was 0.2 % lower; total solids was 9.4 % higher, and solids not fat was 0.4 % higher than the control. But its effect was significant ($P<0.01$) on protein percentage, which was higher in treated cows milk by 2.4 % over the control, Table (2).

Similar results were recorded in most of the previous studies that milk yield increased without changes in its components, Stanisiewski, *et al.*, (1994); Chalupa, *et al.*, (1996); Tarazon, *et al.*, (2000) and Moallem, *et al.*, (2000).

In the other side some studies, Elvinger, *et al.* (1988) reported that daily injection of rbST stimulated large daily increases in production of milk and milk constituents. Bauman, *et al.*, (1999), also reported increased yield of milk, fat and protein in treated herds.

Milk Constituents throughout the experimental period for control and rbST treated cows are presented in Fig (11-15).

Sequence of rbST injection significantly affected the concentration of protein, lactose, total solids and solids not fat ($P<0.001$) as well as fat. In this consept, fragmentary results were recorded.

Soderholm, *et al.*, (1988) reported that daily administration of rbST affected significantly ($P>0.05$) milk production, but did not affect milk fat, protein or total solids percentage. Gallo and Block, (1990a) stated that milk fat and protein were not affected by rbST injection. Chalupa, *et al.*, (1996) did not have a significant impact on concentration of milk fat at any of the lactation periods. Also, they found that daily injection of rbST did not affect the concentrations of protein and total solids.

2.3. Somatic cell counts.

Somatic cell count was higher ($P<0.05$) in injected cow's milk than the control by 30.6%. Values of milk SCC in control and rbST treated cows are presented in Table (2), as well as the variations in milk somatic cell count (SCC X 1000) throughout the experimental period for both control and rbST treated cows are presented in Fig. (16).

Similar increase in SCC treated cows milk were found by Abdel-Nabi, (1992) and Bauman, *et al.*, (1999). However, incidence of mastitis and somatic cell count were not affected by rbST injection. And the pattern of SCC over the lactation cycle was unaffected significantly by treatment. In the other side, Tarazon, *et al.*, (2000) stated that when 500 mg bST was injected every 14 days in Holstein cows the SCC was not affected. Also, Burton *et al.*, (1990) did not found significant difference between low rbST group and control in somatic cell count over 36 weeks.

Table (1): Blood constituents (LSM±SE) as affected by rbST injection.

Blood constituents	Control	rbST treated
Ht, %	22.92[a] ± 0.54	23.52[a] ± 0.53
Hb, g/dl	10.45[a] ± 0.22	10.60[a] ± 0.22
T. protein, g/dl	8.10[b] ± 0.17	8.58[a] ± 0.17
Albumin, g/dl	4.22[a] ± 0.06	4.19[a] ± 0.06
Globulin, g/dl	3.88[a] ± 0.39	4.39[b] ± 0.41
A/G ratio	1.09[a] ± 0.08	1.05[b] ± 0.08
Glucose, mg/dl	33.94[a] ± 0.71	35.97[b] ± 0.72
T. lipids, g/l	8.14[a] ± 0.23	8.81[a] ± 0.23
Triglycerides, mg/dl	98.38[b] ± 3.26	109.28[a] ± 3.29

Means in the same row had different letters differ significantly (P<0.05).

Table (2): Milk constituents(g/dl), somatic cell count(x 1000), and milk yield (kg/305d) (LSM±SE) as affected by rbST injection.

Milk constituents	Control	*RbST treated*
Fat %	2.89[a] ± 0.09	3.21[a] ± 0.09
Protein %	2.38[b] ± 0.02	2.45[a] ± 0.02
Lactose %	4.51[a] ± 0.04	4.70[a] ± 0.04
Total solids %	10.43[a] ± 0.12	10.45[a] ± 0.12
Solids not fat %	7.61[a] ± 0.05	7.61[a] ± 0.05
Somatic cell count(	201.6[a] ± 117.37	290.57[b] ± 118.22
Milk yield*(kg)	3354.1[b]±39.20	4046.1[a]±39.20

Means in the same row had different letters differ significantly (P<0.05).

* Yield in 305 days

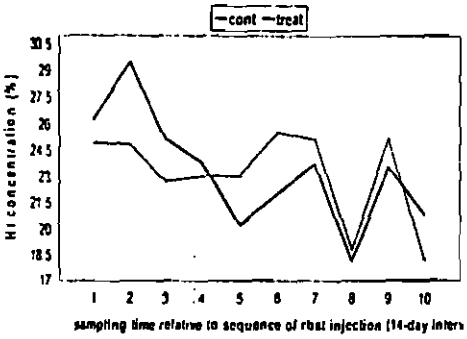

Fig (1): changes in plasma hematocrit concentration for control (Cont) and rbst treated cows throughout experimental period.

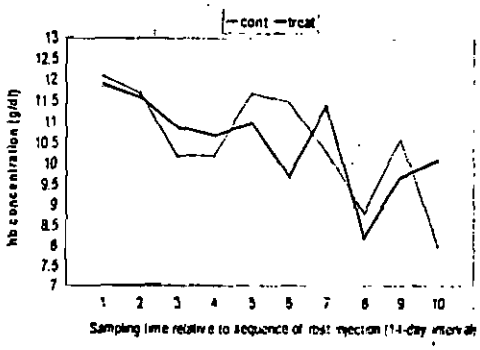

Fig (2): changes in plasma hemoglobin concentration for control and rbst treated cows throughout experimental period.

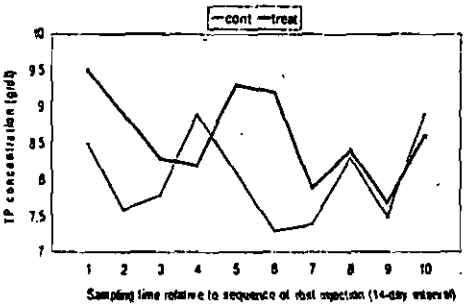

Fig (3): changes in plasma total protein for control and rbst treated cows throughout experimental period.

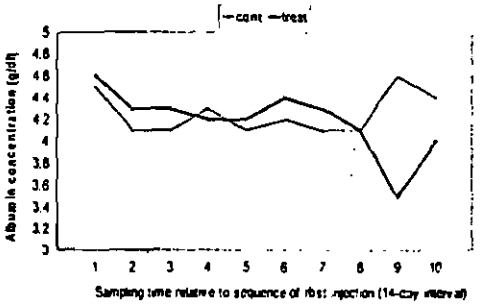

Fig (4): changes in plasma albumin concentration for control and rbst treated cows throughout experimental period.

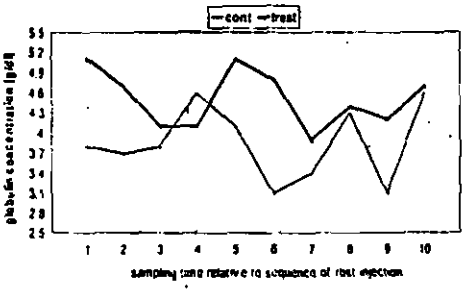

Fig (5): changes in plasma globulin concentration for control and rbst treated cows throughout experimental period.

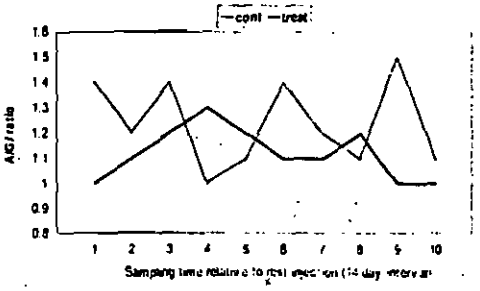

Fig (6): changes in plasma A/G ratio for control and rbst treated cows throughout experimental period.

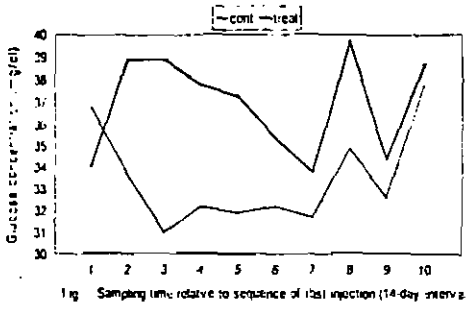

Fig (7): changes in plasma glucose concentration for control (Cont) and rbst treated cows throughout experiment period.

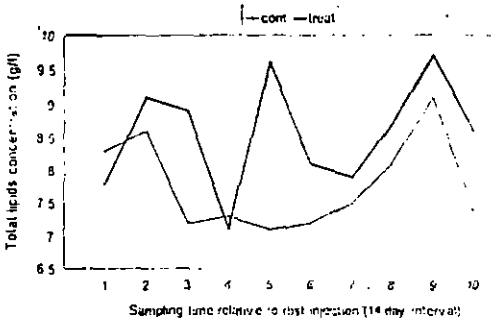

Fig (8): changes in plasma total lipids concentration for control (Cont) and rbst treated cows throughout experimental period.

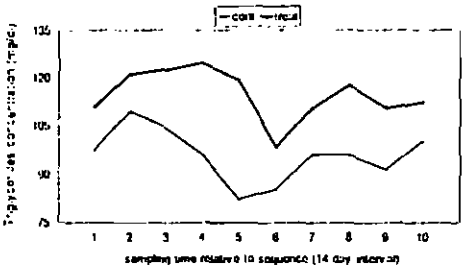

Fig (9): changes in plasma triglycerides concentration for control (Cont) and rbst treated cows throughout experiment period.

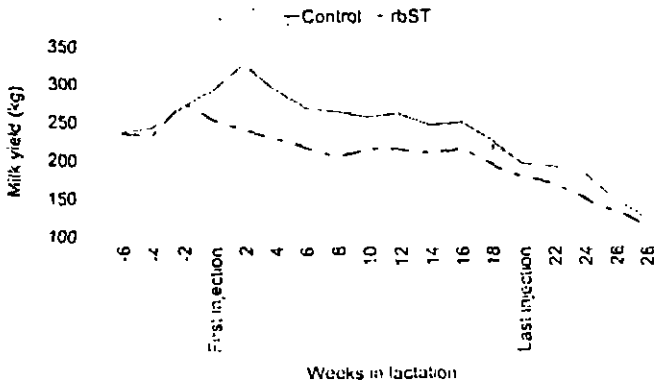

Fig (10). Changes in milk yield for control (C) and rbST treated cows throughout the experimental period

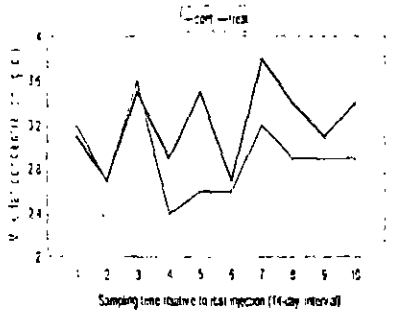

Fig (11): changes in milk fat concentration for control (Cont) and rbst treated cows throughout experimental period.

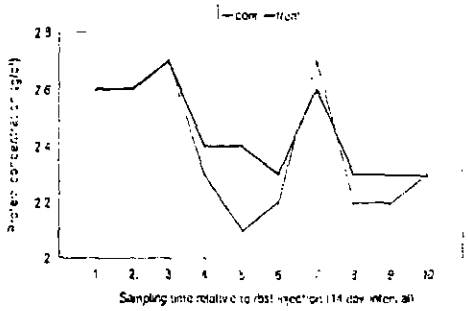

Fig (12): changes in milk protein concentration for control (Cont) and rbst treated cows throughout experimental period.

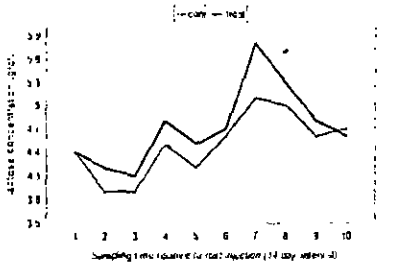

Fig (13): changes in milk lactose concentration for control (Cont) and rbst treated cows throughout experimental period.

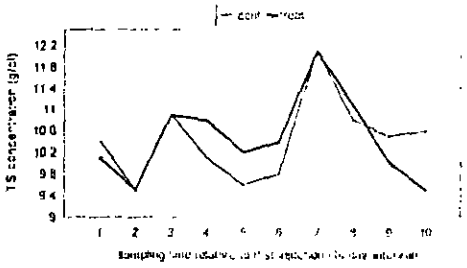

Fig (14): changes in milk total solids concentration for control (Cont) and rbst treated cows throughout experimental period.

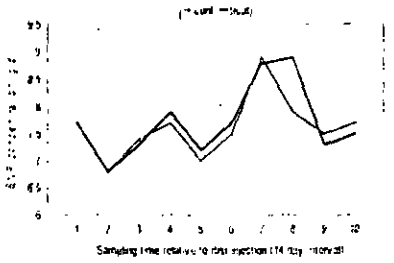

Fig (15): changes in milk SNF concentration for control (Cont) and rbst treated cows throughout experimental period.

Fig (16): changes in somatic cell count (X1000) in milk for control (Cont) and rbst treated cows throughout experimental period.

CONCLUSION

Recombinant bovine somatotropin (rbST), successfully increased 305 days milk yield of Friesian cows by 20.6 % over the control. There was no significant changes in milk constituents due to rbST injection. Injection of rbST did not significantly affect the concentrations of albumin and total lipids in blood plasma and Hb and Ht values in whole blood. But it significantly ($P<0.05$) affect the concentration of total protein, globulin, albumin/globulin ratio, glucose and triglycerids. A ($P<0.05$) significant increase in milk SCC due to rbST injection was noticed, and SCC in milk is still in the normal range. Thus, the results indicated that till the fifth rbST injection, it might be sufficient to increase milk yield throughout the lactation curve and there was no additional increase in milk yield due to more rbST injections.

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تأثير الحقن بهرمون السوماتوتروبين على الإستجابة الفسيولوجية والإنتاجية فى أبقار الفريزيان

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اجريت هذه الدراسه فى محطة بحوث الإنتاج الحيوانى بسخا-محافظة كفر الشيخ-مصر.استخدم فيها ١٤ بقره فريزيان بعد الولاده ب٤٠-٦٠ يوم،تم حقن ٧ بقرات كمجموعة كنترول بمحلول فسيولوجى(٠،٩% كلوريد صوديوم) تحت الجلد،و ال٧ بقرات الاخرى تم حقنها ب ٥٠٠ ملجم من هرمون rbst تحت الجلد بمعدل حقنه كل ١٤ يوم .وأخذت عينات دم ولبن مره كل اسبوعين لمدة ٧ شهور .حيث تم تقدير الهيموجلوبين و الهيماتوكريت فى الدم الطازج بعد اخذه مباشرة ؛ ثم تم فصل البلازما من الدم لتقدير مكونات البلازما (البروتين الكلى-الالبيومين-الجلوبيولين-الليبدات الكليه-الجلسريدات الثلاثيه و الجلوكوز).و سجل محصول اللبن فى فترة الحقن و محصول اللبن المعدل فى ٣٠٥ يوم وتم تحليل مكونات اللبن (البروتين-الدهن-اللاكتوز-الجوامد الكليه-الجوامد اللادهنيه)باستخدام جهاز ال .milkoscan كما تم تقدير العدد الكلى للخلايا الجسديه فى اللبن (scc).و كانت اهم النتائج المتحصل عليها هى :-

الحقن بالهرمون سبب زياده غير معنويه فى كل من الهيموجلوبين و الهيماتوكريت فى الدم الطازج اعلى من الكنترول بنسبة ٢،٦% 1,4% على التوالى .و كان تركيز الهيموجلوبين اعلى فى الابقار المعامله عن الكنترول عند الحقنات الثالثه و الرابعه و السابعه و العاشره.كان للحقن تأثير معنوى($p<0,05$) فى الابقار المعامله عن ابقار الكنترول بنسبة ٢٠،٦% (٤٠٤٦،١ مقابل ٣٣٥٣،١كجم /٣٠٥ يوم)على التوالى حيث كان اعلى فى الابقار المعامله عن ابقار الكنترول عند الحقنات ١٠،٩،٨،٧،٥،٤،٣،٢،١وجد انخفاض غير معنوى فى النسبه المئويه للاكتوز اللبن فى الابقار المعامله عن ابقار الكنترول بنسبة ٠،٢% .وجدت زياده غير معنويه فى الجوامد الكليه للابقار المعامله بالهرمون عن الابقار الغير معامله بنسبة ٩،٤%. كما كان عدد الخلايا الجسديه فى اللبن اعلى فى الابقار المعامله عن الكنترول بنسبة٣٠،٦%.