

Effect of Immunocastration Vaccine Administration At Different Doses on Performance of Feedlot Holstein Bulls

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ABSTRACT

The aim of the study is to determine the effect of immunocastration vaccine administration at different doses on fattening performance of feedlot Holstein bulls. In this research, 94 Holstein male calves assigned to the 4 treatments. Control group; 1 mL of 0.9% saline solution was subcutaneously injected to intact bulls on 1st and 60th days of the feedlot as placebo. On the same days of the feedlot, Immunocastration vaccine (Bopriva®) at two doses of 1 mL and 1 mL for Trial-1 group, 1.5 mL and 1.5 mL for Trial-2 group, 1.5 mL and 1 mL for Trial-3 group were subcutaneously injected to bulls. The feedlot lasted 180 days. Immunocastration vaccine administration at different doses did not affect the live weights (LWs) and cold carcass yields of feedlot Holstein bulls ($P>0.05$). However, it reduced fattening performance between 61-120 days ($P<0.05$) and 1-180 days ($P<0.01$). As a result, it was decreased the fattening performance that administration of Bopriva® at different doses as a GnRH vaccine in Holstein male bulls; whereas it was determined that numerically increase in average daily live weight gain was found in the Trial-2 group than the other groups to which the immunocastration vaccine was applied.

Keywords: GnRH, fattening, immunocastration

Farklı Dozlarda İmmunokostrasyon Aşı Uygulamasının Entansif Koşullarda Yetiştirilen Holstein Erkek Danalarının Besi Performansı Üzerine Etkisi

ÖZ

Bu çalışmanın amacı, farklı dozlarda GnRH aşısının Holştayn erkek buzağlarında besi performansı ve karkas randımanı üzerine etkisinin belirlenmesidir. Araştırmada, 94 baş Holştayn ırkı erkek buzağı kullanılmış ve rastgele 4 gruba ayrılmıştır. Besinin 1. ve 60. gününde kontrol grubuna plasebo olarak 1 mL %0.9'luk tuzlu su çözeltisi derialtı yolla enjeksiyon yöntemi ile uygulanmıştır. Besinin aynı günlerinde, Deneme-1 grubundaki buzağlara 1 mL ve 1 mL, Deneme-2 grubundaki buzağlara 1.5 mL ve 1.5 mL ve Deneme-3 grubundaki buzağlara ise 1.5 mL and 1 mL olmak üzere iki doz immunokastrasyon aşısı (Bopriva®) derialtı yolla enjeksiyon yöntemi ile uygulanmıştır. Besi 180 gün sürüştür. Farklı dozlarda immunokastrasyon aşısı uygulamasının entansif koşullarda yetiştirilen Holştayn erkek danalarında, canlı ağırlık ve karkas randımanı üzerine etkisinin olmadığı belirlenmiştir ($P>0.05$). Buna karşın immunokastrasyon aşısı uygulamasının besinin 61-120 ($P<0.05$) ile 1-180. gün ($P<0.01$) arası dönemde besi performansını azalttığı belirlenmiştir. Sonuç olarak, Holştayn erkek danalarında GnRH aşısı olarak Bopriva®'nın farklı dozlarda uygulamasının; besi performansını düşürdüğü buna karşın immunokastrasyon aşısı uygulanan gruplar içinde rakamsal olarak en yüksek canlı ağırlık artışının Deneme-2 grubunda olduğu tespit edilmiştir.

Anahtar Kelimeler: GnRH, besi, immunokastrasyon

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INTRODUCTION

Castration of male animals is a widespread farming method reported in the literature for more than 50 years and is used world-wide in controlling fertility. Castration has been commonly conducted to enhance growth, metabolism, carcass, and meat quality through decreased pH in the carcasses. It has also been used to improve body fat deposition, reduce aggressive and sexual behaviour for handling the animals in an easier manner, to obtain less carcass damage and to improve animal welfare for animal producers, consumers and owners. Unless the animals are not castrated, they may become dangerous because of aggressive behaviours among themselves and to the people who handle them (Wierbicki et al. 1955, Field 1971, Lofthouse and Kemp 2002, Duff and McMurphy 2007, Freitas et al. 2008, Amatayakul-Chantler et al. 2012, Miesner and Anderson 2015).

Surgical castration is commonly applied, although different castration methods are applied in animals. However, surgical castration (i.e. gonadectomy) usually comes with complications (stress, pain, discomfort etc.) and consequent reductions in post-castration performance (decrease in feed efficiency and rate of growth, and elongated deterioration in productivity etc.) (Marti et al. 2015, Ison et al. 2016).

Vaccination for gonadotropin-releasing hormone (GnRH), which is also called as immunocastration, is considered to be an animal-friendly alternative for surgical castration has received particular attention in male and female mammals. Both for males and females, GnRH, a hypothalamic hormone, has an important role in the regulation of reproductive functions. For this reason, immunization for GnRH (GnRH vaccine) ends up in the neutralization of endogenous GnRH with the subsequent suppression of the gonadotropin-luteinizing hormone (LH) and follicle-stimulating hormone (FSH) expression by anterior pituitary. As a result of this, testicular testosterone and androsterone production is reduced (Bonneau and Enright 1995, Thompson 2000).

GnRH secretion have marked increases after 4 months of age (happening at the same time with the increase in the secretion of LH) in Bull calves, at which time prepubertal transition and testicular development begins (Rodriguez and Wise 1989, 1991). However, benefits on carcass enhancement and testicular growth resulted with one immunization in 4 - 12 months of age (Adams et al. 1996).

The potential to use GnRH vaccine has caused specific attention in major livestock including cattle (Robertson et al. 1979, Finnerty et al. 1998, Huxsoll et al. 1998), goats (Godfrey et al. 1996), pigs (Caraty and Bonneau 1986, Molenaar et al. 1993, Meloen et al. 1994) and sheep (Clarke et al. 1978, Brown et al. 1995, Clarke et al. 1998).

A cattle-specific GnRH vaccine (for immunocastration) (Bopriva®, Zoetis Australia Ltd., West Ryde, Australia) was approved to be used in heifers and bulls in New Zealand, Australia, Mexico, Brazil, Argentina, Turkey, and Peru (Balet et al. 2014). The immunocastration vaccine is applied in 2 doses. With the 1st dose, the bovine immune system is prepared; and the immune response is activated with the 2nd dose. The animal is deemed immunocastrated only when the second dosage (i.e. the booster) is applied (Hennessy 2008). Suppression of GnRH in the hypothalamic axis through antibody induction by GnRH vaccine, reduced the testosterone concentration released, and as a result, the function of the gonads (Sherwood et al. 1993).

It has been reported in several studies conducted before that immunological castration may be very effective to prevent aggressive and sexual behaviour in bulls (Jago et al. 1997a, Marti et al. 2015, Price et al. 2003), but, literature data show that there is no clear effect of immunocastration on performance. The growth of immunocastrated animals was reported to be equal to castrates and less in intact bulls (Cook et al. 2000; Ribeiro et al. 2004, Hernández et al. 2005), intermediate between those that are intact and castrates (Adams et al. 1996, Aïssat et al. 2002) or equal to bulls that are intact (Adams and Adams 1992, Finnerty et al. 1994, Adams et al. 1996, Huxsoll et al. 1998, D'Occhio et al. 2001, Amatayakul-Chantler et al. 2012, Pérez-Linares et al. 2017).

In order to cover the increasing red meat demands of the ever-increasing population of the world, different strategies have been developed and different husbandry methods are used as well as castration. Although those who deal with livestock for meat have used high meat yield cattle bred as Angus and Charolais, they thought of fattening Holstein bull calves as an option, provided that they yield certain advantages to cattle producers like obtaining high-quality carcass (Duff and McMurphy 2007).

When it is considered that the studies in which the effects of immunocastration on growth performance are investigated are limited in number, and the fact that Holstein male calves are

used to produce red meat by producers of livestock for meat are considered together, the purpose of the present study is to define the immunocastration dose that ensures the best breeding performance and to investigate the effects of immunization against gonadotropin-releasing hormone at different doses on feeding performance in Holstein male calves.

MATERIAL and METHODS

All animal-use protocols were carried out in accordance with Directive 2010/63/EU of the European Parliament and Council of 22 September 2010 on the protection of animals used for scientific purposes (EUD 2010). Research was conducted according to the institutional committee on animal use (protocol/file number 2016/16).

A total of 94 Holstein male calves (309.5 ± 2.58 kg LW and 267 days old) were distributed to one of the 4 treatment groups: intact bulls (Control), animals vaccinated with first and second (60 days after the first vaccination and starter of the feedlot) dose of with GnRH (vaccinated) which dose are 1.0 mL and 1.0 mL (Trial-1), 1.5 mL and 1.5 mL (Trial-2), 1.5 mL and 1.0 mL (Trial-3), respectively. The study was conducted in a private farm in Sirvan County of the Siirt province.

Between the arrival and the time when the trial started, the animals were handled in an equal manner. During the trial, animals were blocked based on BW. The animals were fed with the same feed (50.0% corn, 15.0% barley, 10.0% soybean meal, 12.2% sunflower meal, 1.75% limestone, 0.50% salt, 0.25% DCP, 0.3% premix; 16.1% CP, 5.2% ash, 11.2 Mcal MJ/kg; DM basis) and barley straw (4.1% CP, 6.3% ash; DM basis) ad libitum throughout the experiment. On day 0 and 60 of the feedlot, different doses of GnRH vaccine (Bopriva®, Zoetis, Turkey) was given subcutaneously to animals in treatment group on neck's left side with a 12.5-mm 16-gauge needle in one dose with a safety vaccinator. On the same days of the feedlot, 1.0 mL of 0.9% saline solution was injected subcutaneously to control group as placebo.

In order to adopt the calves to the feed that will be used in breeding in 14 days, the feed was increased slowly before the study started. The animals were weighed with a scale in every 15-day period to determine their LWs. The feeding lasted for 180

days. With the help of the LWs taken initially, at the end of the feeding period, and in 15-day periods, the LW and average daily live weight gain (ADG) were determined in various periods. In addition, 12 animals were slaughtered from each group after the feeding period, and the hot and cold carcass yields were determined.

The statistical analysis for normal distribution data of the treatment groups was carried out with the general linear model procedure of SPSS software 20.0 (SPSS Inc., Chicago, IL, USA). The results are given as mean $\pm$ standard deviation. Duncan's multiple range test was employed for multiple comparisons in important groups. Data points with different letters were considered to be different at a significant level ($P \leq 0.05$).

The data were statistically analyzed using general linear model procedure adopted by SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA) statistics software with One-way ANOVA. The results are given as mean $\pm$ standard deviation. Data points with different letters were considered to be different at a significant level ($P \leq 0.05$). Statistical significant effects were further analyzed and means were compared using Duncan's multiple range test.

RESULTS

In different periods of the feeding, it was determined that the immunocastration application at different doses did not have any effects on LW of the Holstein male calves ($P < 0.05$). However, applying immunocastration at different doses reduced the ADG in the period between days 61 and 120 ($P < 0.01$) and throughout the feeding period (days 1-180) ($P < 0.05$) and also reduced the ADG. In other words, it was determined that the ADG of the calves in the Control Group were higher than the ADG of the calves throughout the feeding and between the days 61-120 when compared with the trial groups. In addition to this, it was determined that there were no statistically significant differences between the trial groups in terms of ADG ($P > 0.05$) (Table 1).

It was also determined that applying immunocastration at different doses did not affect the hot carcass weight, hot carcass yield, cold carcass weight, and cold carcass yield of Holstein male calves ($P > 0.05$) (Table 2).

Table 1. Effect of Immunocastration Vaccine Administration at Different Doses on live weight and daily live weight gain in various periods in Feedlot Holstein Bulls

Tablo 1. Holştayn Erkek Danalarında Farklı Dozlarda İmmunokastrasyonun çeşitli dönemlerdeki canlı ağırlık ve günlük canlı ağırlık artışı üzerine etkisi

	Control	Trial-1	Trial-2	Trial-3	P-Value
<i>Live Weight</i>					
Initial	309.21±5.49	306.62±4.22	312.11±5.45	315.39±5.23	0.652 ^{ns}
30 th	343.72±5.29	338.30±4.28	345.41±6.39	345.70±7.06	0.693 ^{ns}
60 th	384.72±5.46	374.95±4.40	381.96±6.77	385.05±8.59	0.501 ^{ns}
90 th	426.93±6.28	412.39±4.70	419.13±7.74	425.44±10.21	0.325 ^{ns}
120 th	474.32±6.48	452.53±4.83	463.18±7.81	462.95±10.7	0.137 ^{ns}
150 th	518.98±6.68	492.62±4.94	507.31±7.25	501.19±11.43	0.053 ^{ns}
180 th	560.88±8.27	536.67±5.35	548.56±8.36	548.25±11.95	0.144 ^{ns}
<i>Average Daily Live Weight Gain</i>					
1-60 th	1.26±0.05	1.14±0.02	1.16±0.06	1.16±0.07	0.210 ^{ns}
61-120 th	1.49±0.05 ^a	1.29±0.02 ^b	1.35±0.05 ^b	1.30±0.05 ^b	0.001 ^{**}
121-180 th	1.44±0.08	1.40±0.03	1.42±0.06	1.42±0.04	0.938 ^{ns}
1-180 th	1.40±0.04 ^a	1.28±0.02 ^b	1.31±0.03 ^b	1.29±0.04 ^b	0.016 [*]

^{a, b}: Means with different superscripts in the same column differ significantly (P<0.05).

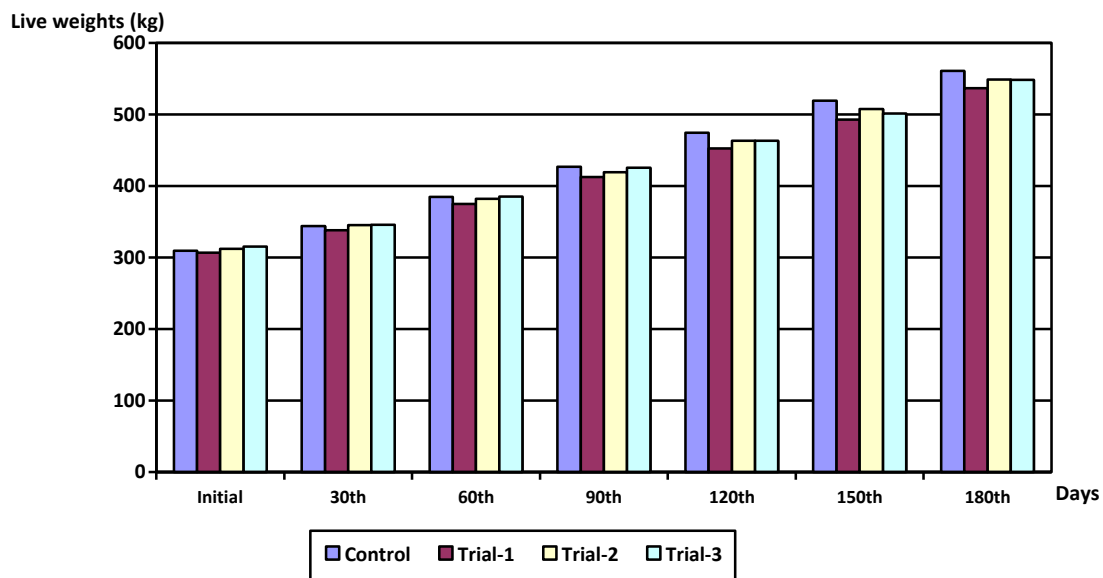
^{ns}: non-significant (P>0.05); ^{*}: P<0.05; ^{**}: P<0.01.

Table 2. Effect of immunocastration vaccine administration at different doses on carcass weight and percentage in feedlot Holstein bulls

Tablo 2. Holştayn Erkek Danalarında Farklı Dozlarda Bopriva ile İmmunokastrasyonun karkas ağırlığı ve oranı üzerine etkisi

	Control	Trial-1	Trial-2	Trial-3	P-Value
Hot carcass weight	291.86±10.55	279.21±4.94	282.96±5.01	289.93±6.28	0.451 ^{ns}
Hot carcass percentage	52.87±0.62	51.45±0.40	52.02±0.49	51.97±0.44	0.308 ^{ns}
Cold carcass weight	284.81±10.34	273.07±4.87	278.99±5.52	283.26±6.23	0.517 ^{ns}
Cold carcass percentage	51.59±0.61	50.32±0.40	50.85±0.46	50.77±0.45	0.398 ^{ns}

^{ns}: non-significant (P>0.05).



Graphic 1. The live weights at different periods in feedlot Holstein bulls

Grafik 1. Holştayn erkek danalarda besinin farklı dönemlerdeki canlı ağırlıklar

DISCUSSION

The LW, ADG, and carcass weight and yield are significant properties for farmers, livestock producers and industry. As well as providing heavier commercial cuts, heavier carcasses allow to diffuse costs by optimizing the industrial process. They are also payment to producers. In addition to these, it is significant to have a pattern as carcasses of different weights make it compulsory to have similar labour and process time; however, they have clear industrial profitability (Pazdiora et al. 2013).

It was determined that the GnRH vaccine at different doses did not have any effects on the LW of the animals in different periods of the trial in Holstein bulls vaccinated on days 0 and 60. These results were similar to those reported by Adams and Adams 1992, Freudenberger et al. 1993, Finnerty et al. 1994, Huxsoll et al. 1998, D'Occhio et al. 2001, Amatayakul-Chantler et al. 2012, Marti et al. 2013, Pérez-Linares et al. 2017, and different from those reported by Adams and Adams 1992 and Amatayakul-Chantler et al. 2013.

The results of previous studies show that the magnitude of the response in immunocastration has different effects for bulls. The heterogeneity in the results reported previously stems from the use of different vaccine formulation in previous studies, applying different vaccine programs (one, two or three booster doses, different duration of effect from booster-slaughter date), using different race, using implant or not, the difference in husbandry or management practice and from the different types of feed.

Steroid hormones stimulate hypertrophy of the neck, chest and rump muscles, and provide a more forequarter yield (Pazdiora et al. 2013). The impact of testosterone on intact males that develop muscles throughout life occur because of increased nitrogen retention (Galbraith et al. 1978). Prior et al. 1983 claimed that testosterone had an effect that inhibits lipogenic enzyme activities in adipose tissue and induces higher basal lipolytic rates. GnRH-vaccinated cattle, other factors, such as modified sexual or aggressive behaviour may assist in maintaining growth compensating for the decreased natural anabolic hormone testosterone concentrations (Jago et al. 1997b, Price et al. 2003, Amatayakul-Chantler et al. 2012).

In the present study, it was determined that the LW of the calves to which immunocastration was applied were lower than the calves that were included in the Control Group in terms of numbers. In addition, this situation may be referred

to the fact that the LW of the calves to which immunocastration is applied may be lower than the calves included in the Control Group in terms of numbers depending on the longer duration for fat deposition in the calves to which immunocastration is applied when compared with the intact calves and with the foresight claiming that testosterone has a lipogenic inhibitory effect on the enzymatic activity of the fat tissue that increases the basal level of the lipolytic activity because of the anabolic effect of testosterone explained above (Coutinho et al. 2006, De Freitas et al. 2015, Andreo et al. 2016).

In the present study, the result showing that applying immunocastration at different doses on days 61-120 ($P<0.01$) and throughout the feeding period (days 1-180) ($P<0.05$) reduces ADG was similar to the result reported by Marti et al. 2017 and Moreira et al. 2017; and different from the result reported by Adams et al. 1993, Huxsoll et al. 1998, Cook et al. 2000, Amatayakul-Chantler et al. 2012, Pérez-Linares et al. 2017.

It was determined that applying immunocastration at different doses did not affect the carcass weight and yield in Holstein male calves; however, this application reduced the carcass weight and yield in terms of numbers when compared with the Control Group. It was verified in previous studies that there are no differences in carcass dressing % between intact bulls and the animals that were vaccinated (Adams and Adams 1992, Adams et al. 1993, Freudenberger et al. 1993, Ribeiro et al. 2004, Amatayakul-Chantler et al. 2012, Marti et al. 2013). On the other hand, unlike our study, some previous studies reported that carcass percentage of bulls was higher compared to that of vaccinated animals (Huxsoll et al. 1998, Cook et al. 2000). The reduced carcass percentage in vaccinated animals compared to bulls may be explained by the taking away of the excessive fat around the kidneys and heart, and from the pelvis of the carcasses.

CONCLUSIONS

Physical castration causes stress and reduces performance in animals, on the other hand active immunization against GnRH maintains (or with slight reduce) performance by maximizing welfare in bulls, and controls unwanted sexual and aggressive behavior. Considering these facts about physical- and immunocastration, it was decreased the fattening performance that administration of Bopriva® at different doses as a GnRH vaccine in Holstein male bulls; whereas it was determined that numerically increase in average daily live weight gain was found in the Trial-2 group than the other

groups to which the immunocastration vaccine was applied.

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