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Predicting Kidding Date Using Prepartum Milk Calcium Concentrations and Comparing Kid Growth to Colostrum Quality in Goats

Justin M. Hamm
University of Arkansas, jmsupernatural@gmail.com

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Cover Page Footnote

Justin M. Hamm is a December 2018 honors program graduate with a major in Animal Science. Jason Apple, the faculty mentor, is a professor in the department of Animal Science.

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Meet the Student-Author



Justin Hamm

Research at a Glance

- There is a need for meat goat related research because there is a growing demand in the United States.
- There does not seem to be a relationship between goat milk calcium levels two days prior, one day prior, and on the day of birth that would assist producers in predicting an expected kidding date.
- An increased colostrum density in goats does not indicate an increase in kid weight gain.

I am an Eagle Scout and was homeschooled on my parent's cattle ranch in Alpena, Arkansas. I also raise a small goat herd, work with horses, and help manage my family's herd of cattle. I graduated from North Arkansas College with an Associate of Arts degree in 2016, where I was an active member of the Ag club and Phi Theta Kappa. My major is in Animal Science with a Pre-Professional concentration, and I will graduate magna cum laude from the University of Arkansas in December 2018. I have also been an active member of the Pre-Vet club, and had the opportunity to participate in a faculty led study abroad program to New Zealand and Australia. I would like to thank my mentor Dr. Jason Apple and my committee members Dr. Kathy Jogan and Dr. Charles Rosenkrans. I am grateful to Dr. Apple and Jogan for providing me with their resources and support throughout the Honors program process, and Dr. Rosenkrans for encouraging me to pursue my interests while developing my thesis. I would also like to thank my academic advisor Dr. Jeremy Powell for being willing and able to answer all of my questions and my family for their unfailing support while conducting my study.



Justin at Maits Rest Rainforest Walk in the Great Otway National Park near Apollo Bay, Victoria, Australia while on a study abroad trip in Jan. 2017 to study human and animal interactions in New Zealand and Australia.

Predicting kidding date using prepartum milk calcium concentrations and comparing kid growth to colostrum quality in goats

Justin M. Hamm^{*} and *Jason Apple*[†]

Abstract

Goats have an ancient history with humankind and are used as a red meat source around the world. This provides an opportunity in Arkansas agriculture. There is a gap in goat research that facilitated the conception of the study's objectives to determine whether prepartum milk in goats showed a rise in calcium levels within 24 to 48 hours of kidding and to ascertain whether an increased colostrum density is indicative of increased weight gain in kids. Eleven does were bred out of season and monitored for mammary development. Then, 5 to 15 mL of prepartum milk were collected, and the calcium content was measured using a Chemetrics K-1700 system. Postpartum, a 20 mL sample of colostrum was collected and the density was tested using an Equine Colostrometer, antifreeze tester, and a Refractometer. Each kid was also weighed at birth, 30, 60, 90, and 120 days of age using a *Premier 1* 110-lb scale. The weight was adjusted for age of dam, sex of kid, and birth type/rearing. The relationship between adjusted weights and colostrum quality and the relationship between calcium levels 24 and 48 hours prior to kidding with calcium levels at birth were analyzed using correlation and regression procedures. There was a negative correlation between the adjusted weights and colostrum quality; however, the relationship was not significant ($P > 0.05$). Positive correlations between calcium levels at 24 and 48 hours prior to kidding and at birth were not significant ($P > 0.05$). Moreover, the colostrum quality did not have an impact statistically on kid growth, and there was no significant rise in the calcium concentration of prepartum milk samples that could be used to estimate the time of birth.

^{*} Justin Hamm is an honors program December 2018 graduate with a major in Animal Science with a Pre-Professional concentration.

[†] Jason Apple is the faculty mentor and a Professor in the Department of Animal Science.

Introduction

Goats have been domesticated for an estimated 10,000 years (Zeder and Hesse, 2000). Furthermore, there are approximately 450 million goats across the globe (McKenzie-Jakes, 2007), as opposed to the population of cattle which has reached almost a billion (USDA, 2016). However, this is a 50% increase in the number of goats while the total population of cattle has increased by only 9% over the past twenty years (Anaeto et al., 2010). One of the advantages that goats have over other species of domestic livestock is that they are browsers, which allows them to survive on low quality forage. Due to their unique physiology, they can consume noxious weeds that may be toxic or unpalatable to other species. In addition, they commonly produce litters of one to three kids (McKenzie-Jakes, 2007). In some breeds, although it is not recommended, females can become pregnant as young as four to six months of age, which makes them “the most prolific of all domesticated ruminants” (Anaeto et al., 2010).

Goat meat is nutritious. It is relatively low in fats, sodium, and cholesterol in comparison to other livestock species (Anaeto et al., 2010), in part because goats tend to store less external fat deposits than sheep or cattle (McKenzie-Jakes, 2007). The meat contains a high concentration of iron and potassium. Furthermore, the protein content is compatible to other ruminants (Anaeto et al., 2010). As a result, their meat is the most commonly utilized source of red meat in the world (Harper, 2010).

In the United States, goats are produced predominantly for the management of invasive plant species and the production of chevon and cabrito, which are commonly used French and Spanish terms for goat meat (Glimp, 1995). In addition, the utilization of goats to manage invasive plant species has a long history in the United States. Some of America’s first goats were introduced in Texas by the Spanish to develop and improve pasture quality for other livestock, and to control brush that competes with crops (Glimp, 1995). As a result, goats can be utilized as a more sustainable and environmentally friendly alternative to the use of herbicides. The U.S. supply of goat meat does not currently meet the demand of the increasing ethnic populations (Glimp, 1995). Consequently, the meat goat industry in the United States is expanding (Glimp, 1995).

According to data collected by the United States Census Bureau, 23% of the population of Arkansas is made up of ethnic minority groups (DADS, 2010), thereby serving as a potential economic opportunity for Arkansas farmers. The rocky soil and pervasiveness of weeds and brush in the Arkansas Ozarks provides goats with an environment to which they are well adapted (Arkansas Geological Survey, 2010).

Additional experimentation and analysis would benefit the meat goat industry by providing the public with a better understanding of the industry’s significance (Dubeuf, et al., 2004). The average gestation for goats is 150 days. However, the gestation period varies widely depending on the age of the goat, time of year, and breed of goat. The expected kidding date may occur at any time within a two-week window (Barkley, et al., 2017). Because multiple births are common, a better method is needed to narrow down a goat’s expected kidding date to improve efficiency. This information is especially critical when goats are kidding for the first time or they are elderly, to prevent loss due to reproductive difficulties, such as dystocia and ringwomb (Hussain and Zaid, 2010). Furthermore, a thorough review of literature revealed that there has not been research investigating the effect that the colostrum density in does has on weight gain in kids.

To meet the purpose of the study, the following objectives were created:

1. To ascertain whether an increased colostrum density is indicative of increased weight gain in kids.
2. To determine whether prepartum milk in goats showed a sudden rise in calcium levels within 24 to 48 hours of kidding.

Materials and Methods

Eleven Kiko/Spanish cross does had conceived and were available to utilize in the study. The goats were on average three years of age. The goats were first exposed to a buck out of season, and all the goats but one had previously kidded in the same calendar year. They were observed daily for signs of mammary development. During the day, they were allowed to forage, then herded into a 24 × 36-ft pen which contained a 12 × 36-ft shelter with straw bedding each evening. Once signs of mammary development were observed, a 5- to 20-mL prepartum milk sample per doe was collected into a 50-mL plastic tube every evening. Following collection, each sample was refrigerated before being tested for calcium content using Chemetrics K-1700 testing system (Chemetrics, Inc., Midland, Virginia). Post-kidding, a 20-mL colostrum sample was collected from each doe, refrigerated, and tested for density using an Anti-freeze tester (Custom Accessories, Richmond, Illinois), refractometer (Animal Reproduction Systems, Inc., Chino, California), and an Equine colostrometer (Jorgensen Laboratories, Inc., Loveland, Colorado). Weights of the kids were collected at birth, 30, 60, 90, and 120 days using a *Premier 1* 110-lb Digital scale (Premier 1 Supplies, Washington, Iowa).

The weights of each kid at 30, 60, 90, and 120 days were multiplied by published adjustment factors according to

sex of kid, age of dam, and birth type (the number of kids carried to term)/rearing (the number of kids that the doe is able to raise). These adjustment factor values were provided by David R. Notter, Ph.D., Virginia Tech (as cited in Browning, 2014). Additionally, the data were analyzed to compare total weight per doe and adjusted kid weights to colostrum quality measurements taken with the colostrometer, anti-freeze tester, and the refractometer using linear regression and correlation procedures of Excel and SAS (SAS Institute, Inc., Cary, N.C.). Correlation r values less than 0.5 were described as weak, and values greater than 0.5 were described as strong.

Results and Discussion

To compare weight gain, the adjusted kid weights were also calculated to give a more accurate representation of gain in kids (Fig. 1). When analyzing the correlation between the adjusted total weights to the data measured by the colostrometer, the r -value indicated that there was

a weak correlation ($r < 0.5$; Table 1). The r -values when correlating the adjusted total weights to the refractometer percentages were slightly higher at birth and 30 days than the other days measured; however, all the correlations were weak ($r < 0.5$; Table 1). The regression procedure was used to determine if the relationship between the adjusted total weights at each time interval and the colostrum density, measured by the colostrometer and the refractometer, was significant. None of the P -values given in the procedure were less than the significance level of 0.05, indicating that the relationships between the adjusted total weights and colostrum density were not significant. This is supported by the weak trendline fit of the regression plot in Figs. 2 and 3.

The calcium levels of the samples collected two days prior to birth were correlated with the calcium levels of the samples collected one day prior and on the day of birth. Each of the correlations was weak and positive ($r < 0.5$; Table 2) with the relationship between one day and two days prior to birth being the strongest, and the day

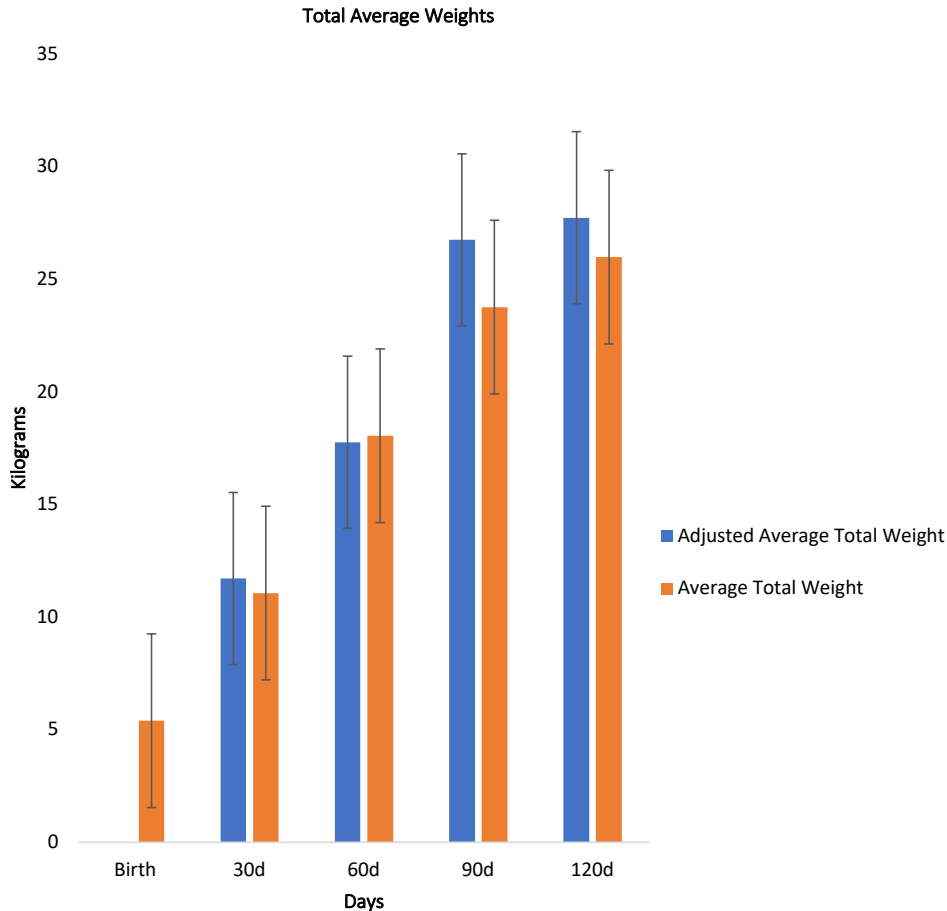


Fig. 1. Average and adjusted kid body weights per the eleven does utilized for the study from birth to 120 days of age.

Table 1. Pearson correlation coefficients (*r* values) between age of Dam (AoD), Birth Type (Btype), rearing type (Rtype), colostrometer (ColM), refractometer (Refr), anti-freeze tester (AnFz), birth (Bwt), 30-d, 60-d, 90-d, and 120-d adjusted weights.

Characteristic	AoD	Btype	Rtype	ColM	Refr	AnFz	Bwt	30-d	60-d	90-d	120-d
AoD	-	0.42	0.69	0.76	0.22	0.77	0.22	-0.14	-0.10	0.23	0.30
Btype		-	0.87	0.24	0.20	0.33	-0.39	-0.27	-0.35	0.08	-0.05
Rtype			-	0.50	0.07	0.62	-0.33	-0.35	-0.33	0.13	0.05
ColM				-	0.04	0.89	0.32	0.07	-0.09	0.17	0.22
Refr					-	0.20	-0.33	-0.23	-0.14	-0.08	0.00
AnFz						-	0.06	-0.20	-0.19	0.18	0.22
Bwt							-	0.63	0.53	0.42	0.42
30d								-	0.88	0.60	0.61
60d									-	0.76	0.79
90d										-	0.95
120d											-

Blue – ($P < 0.10$).
 Red – ($P < 0.05$).

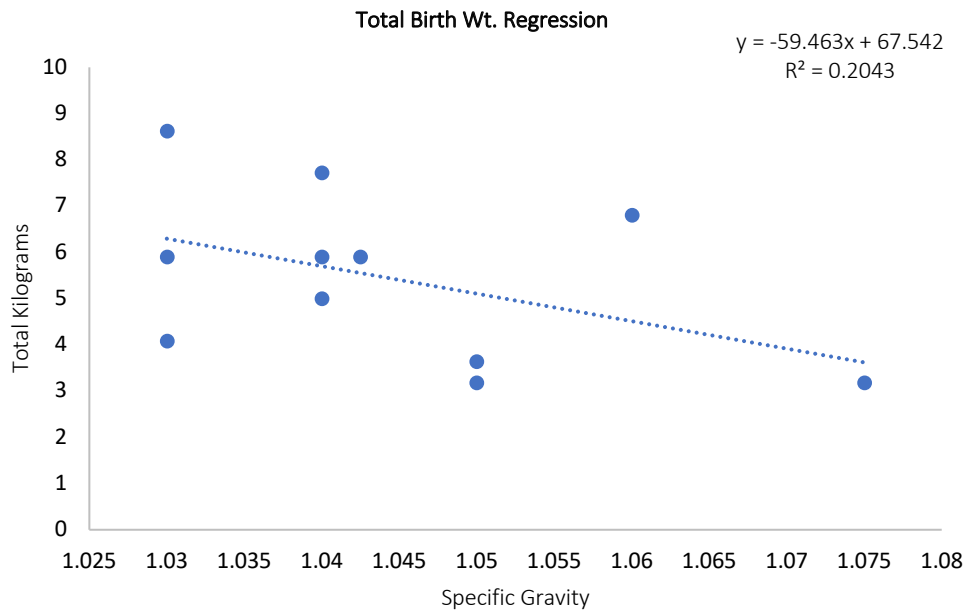


Fig. 2. The relationship between total kid birth weight per doe to colostrometer measurements (specific gravity).

of and two days prior to birth being the weakest (Table 2). The relationships between calcium concentrations were also analyzed for significance using the regression procedure. However, none of the *P*-values indicated that any of the relationships were significant ($P > 0.05$). To the authors' knowledge there are no similar studies that have been previously performed in meat goats.

Conclusions

The results of the study indicated that there was no significant relationship between weight gain in kids and colostrum density. There was also no significant increase in calcium levels of prepartum goat milk within 24 or 48 hours prior to birth. Furthermore, colostrum quality does not seem to influence kid growth, and calcium concentrations are not an indication of imminent birth.

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Table 2. Pearson correlations between the calcium concentrations measured at birth, one day, and two days prior to kidding.

Timing	Birth	1 Day	2 Days
Birth	-	0.22	0.07
1 Day		-	0.45
2 Days			-

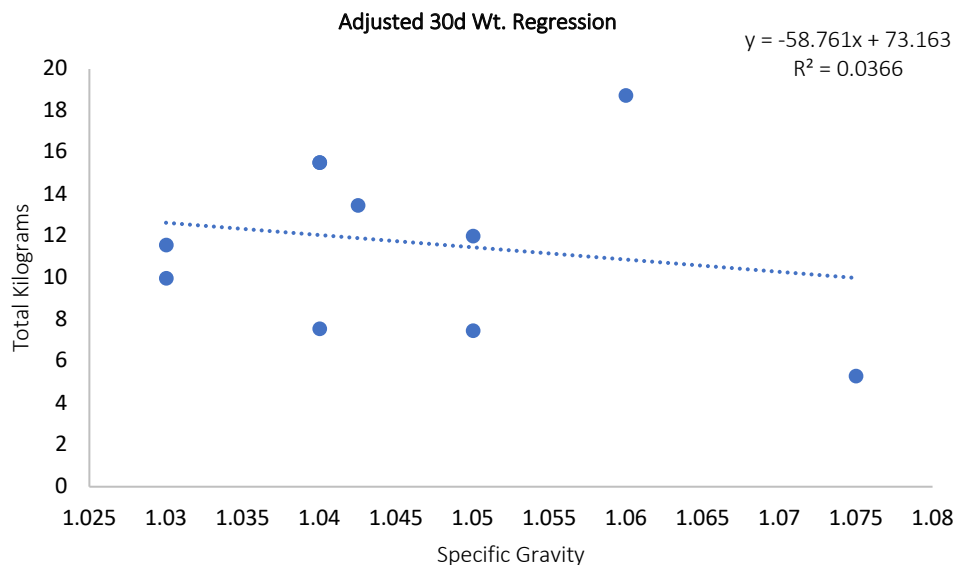


Fig. 3. The relationship between adjusted 30-d kid body weight per doe to colostrum measurements (specific gravity).

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