12-2018

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

Justin Hamm

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

Justin M. Hamm

University of Arkansas

Table of Contents

Abstract

Goats have a very long history with mankind and are commonly used as a nutritious red meat source around the world. The supply of goat meat in the United States does not meet the growing demand from ethnic consumers. This provides an economic opportunity in Arkansas agriculture because goats are uniquely adapted to the Ozark environment. There is a wide gap in caprine research which facilitated the conception of the study's objectives to determine whether prepartum milk in goats showed a sudden 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. For example, eleven does were bred out of season and monitored daily for mammary development. At which time, 5 to 15 mL of prepartum milk were collected nightly, and the calcium content was measured using a Chemetrics K-1700 testing 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# Digital 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 in Excel. There was a weak negative correlation between the adjusted weights and colostrum quality; however, the relationship was not significant ($P > 0.05$). There was also a very weak positive correlation between calcium levels at 24 and 48 hours prior to kidding and at birth. Additionally, the relationships were not significant ($P > 0.05$). Future research studies should contain a larger, more uniform sample size.

Introduction and Literature Review

Economic and Environmental Importance

Global Importance. Goats have been domesticated for an estimated 10,000 years (Hesse & Zeder, 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 only increased by 9% over the past twenty years (Anaeto, Adeyeye, Chioma, Olarinmoye, & Tayo, 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 at a time (McKenzie-Jakes, 2007). In some breeds, although it is not recommended, females can become pregnant as soon as four to six months of age, which makes them "the most prolific of all domesticated ruminants," (Anaeto et al., 2010). Goat meat is also very 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 (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).

National Importance. 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. 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. 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. Consequently, the meat goat industry in the United States is expanding (Glimp, 1995).

Local Importance. According to data collected by the United States Census Bureau, 33% of the population of Arkansas is ethnic (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 that they are well adapted to (Arkansas Geological Survey, 2010).

Problem Statement and Need for Research

As a result, the many benefits of the meat goat industry could be better understood with additional experimentation and analysis (Dubeuf, Morand-Fehr, & Rubino, 2004). Very little research has been done that focusses on goats (McGregor, 1985).

For example, 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, Harper, Kime, & Knoll, 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 & Zaid, 2010).

Furthermore, after a thorough review of literature there has not been any research done concerning the affect that the colostrum density in does has on weight gain in kids.

Methods

Design, Purpose and Objectives

The study was experimental in design. Therefore, to meet the purpose of the study, the following objectives were created:

1. Ascertain whether an increased colostrum density is indicative of increased weight gain in kids.

2. Determine whether prepartum milk in goats showed a sudden rise in calcium levels within 24 to 48 hours of kidding.

Participants and Sampling

Eleven Kiko/Spanish cross does were utilized in the study. The goats were on average three years of age. The number eleven was chosen because that was the number of goats that had conceived and were available during the time of the study.

Data Collection, Treatments, and Instruments

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 by 36-foot pen and a 12 by 36-foot shelter with straw bedding each evening. Once signs of mammary development were observed, a 5 to 20 mL prepartum milk sample were collected into 50-mL plastic tubes every evening. Following collection, each sample was refrigerated before being tested for calcium content using Chemetrics K-1700 testing system. Furthermore, post-kidding, a 20-mL colostrum sample was collected, refrigerated, and tested for density using an Anti-freeze tester, Refractometer, and an Equine Colostrometer. Weights of the kids were collected at birth, 30, 60, 90, and 120 days using a *Premier 1* 110# Digital scale.

Data Analysis

The data were recorded on a paper spreadsheet. Then, it was transferred to an Excel spreadsheet. The weights of each kid at 30, 60, 90, and 120 days were adjusted using adjustment factors for sex of kid, age of dam, and birth type/rearing. Additionally, the data were analyzed to compare total pounds per doe and adjusted kid weights to colostrum quality measurements taken with the Colostrometer, Anti-freeze tester, and the Refractometer using the regression and correlation procedures of Excel and SAS (SAS Inst., Inc., Casy, NC).

Results

When analyzing the correlation between the adjusted total weights to the data measured by the Colostrometer, the R-value indicated that there was a very weak correlation ($R < 0.5$). It is worthy of note that the Anti-freeze and Colostrometer values were highly correlated with the age of the dam. The R-values given when correlating the adjusted total weights to the Refractometer percentages were slightly higher at birth and 30 days; however, the correlation was very weak. The refraction 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. In each case the P-value was greater than the significance level of 0.05, indicating that the null hypothesis should fail to be rejected.

In addition, the calcium levels of the samples collected two days prior to parturition were correlated with the calcium levels of the samples collected one day prior and on the day of parturition. Each of the correlations was weak and positive with the relationship between one day and two days prior to parturition being the strongest, and the day of and two days prior to parturition being the weakest. Each of the relationships were also analyzed for significance using the regression procedure. None of the P-values indicated that any of the relationships were significant ($P > 0.05$); therefore, the null hypothesis failed to be rejected.

Discussion/Conclusion

In conclusion, the results of the study's statistical analysis indicated that there was no significant rise in calcium levels of prepartum goat milk within 24 or 48 hours prior to

parturition. There was also an inverse relationship between weight gain in kids and colostrum density. The study could be improved by analyzing a larger sample size, thereby minimizing the impact of possible outliers skewing the results of the data. Some other factors that may have compromised the results include variation in the age of the does, conception out of the goat's traditional breeding season, environmental contamination of the samples, and the large genetic base causing an increase in variation between samples. In addition, future studies could possibly determine if increased colostrum density was indicative of decreased colostrum production in does, thereby resulting in inadequate immunoglobulin intake.

References

Anaeto, M.; Adeyeye, J. A.; Chioma, G. O.; Olarinmoye, A.O.; Tayo, G. O. (2010). Goat products: Meeting the challenges of human health and nutrition. *Agriculture & Biology Journal of North America*, *1*(6), 1231. Retrieved from http://connection.ebscohost.com/c/articles/56947423/goat-products-meeting-challenges-human-health-nutrition

Arkansas Geological Survey. (2010, August 25). NEHRP soil classification map of arkansas. Retrieved May 3, 2017, from http://www.geology.ar.gov/maps_pdf/geohazards/Soil_Amplification_Map_Of_Arkansas.pdf

Barkley, M. E., Knoll, K., Kime, L. F., & Harper, J. K. (2017, September 6). Meat Goat Production. Retrieved October 22, 2017, from https://extension.psu.edu/meat-goat-production

Data Access and Dissemination Systems (DADS). (2010, October 05). Your Geography Selections. Retrieved May 03, 2017, from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Dubeuf, J. P., Morand-Fehr, P., & Rubino, R. (2004). Situation, changes and future of goat industry around the world. In *Small Ruminant Research* (Vol. 51, pp. 165–173). https://doi.org/10.1016/j.smallrumres.2003.08.007

Glimp, H. A. (1995, January). Meat goat production and marketing. *Journal of Animal Science.*

Harper, J. M. (2010, November 3). What is the world's most popular meat? Retrieved March 27, 2017, from http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=3679

Hussain, S. O., Zaid, N.W., (2010). Dystocia in goats, causes and treatment. *Al-Qadisiya Journal of Veterinary Medical Science, 9 (1),* 63-68. http://qu.edu.iq/vmjou/wp-content/

uploads/2015/01/Vol.-91En.-63-68.pdf

McGregor, B. A. (1985, January). Growth, development and carcass composition of goats: a review. In *Goat production and research in the tropics: proceedings of a workshop held at the University of Queensland, Brisbane, Australia, 6-8 February 1984* (pp. 82-90). Australian Centre for International Agricultural Research.

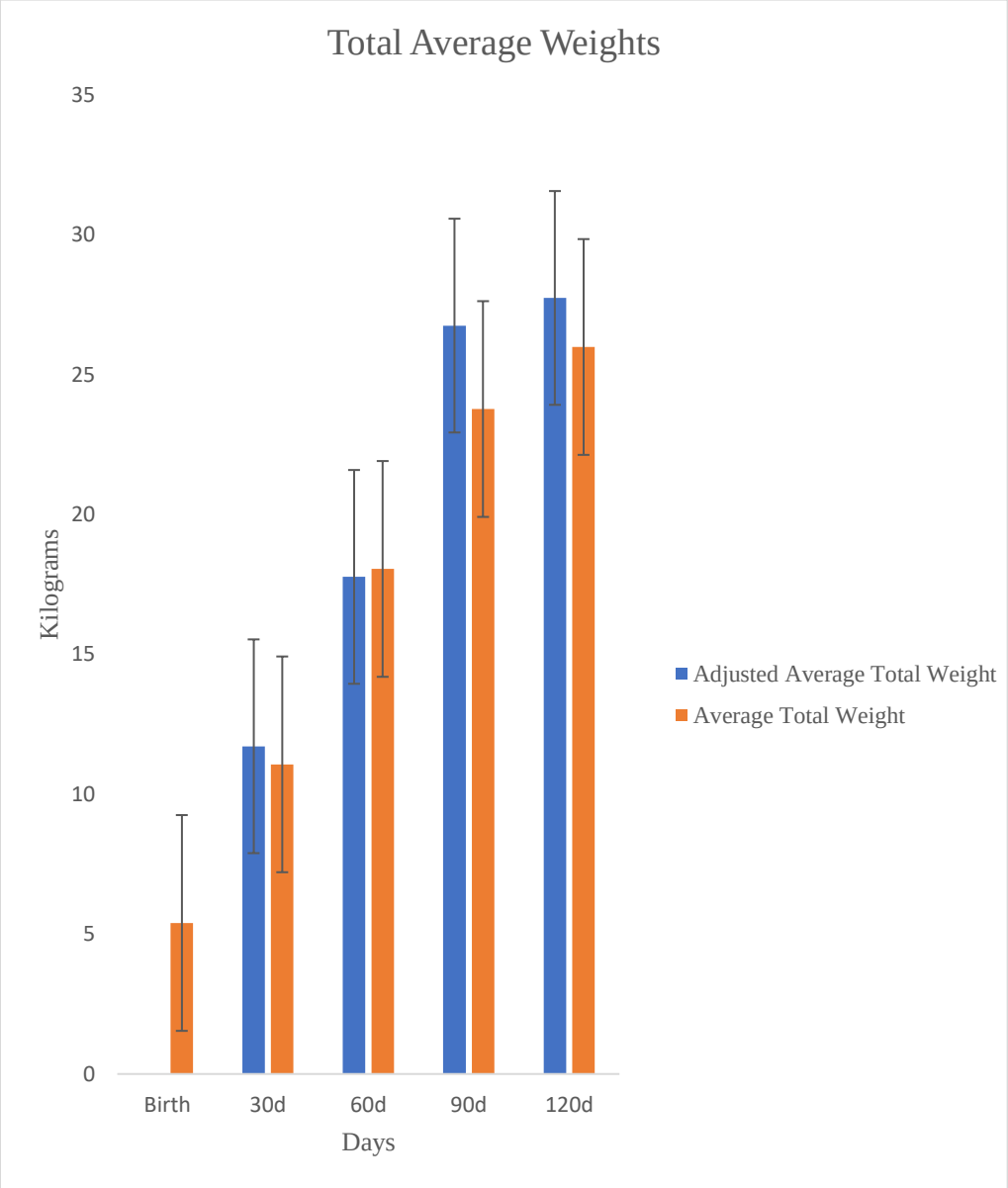
McKenzie-Jakes, A. (2007). Facts About Goats. Retrieved March 26, 2017, from http://www.famu.edu/cesta/main/assets/File/coop_extension/small%20ruminant/goat%20pubs/Facts%20About%20Goats.pdf

USDA. (2016, October). Livestock and poultry: world markets and trade. Retrieved March 26, 2017, from https://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf

Zeder, M. A., & Hesse, B. (2000). The initial domestication of goats (capra hircus) in the zagros mountains 10, 000 years ago. *Science*, *287*(5461), 2254-7. Retrieved from http://0-search.proquest.com.library.uark.edu/docview/213576329?accountid=8361

Tables and Graphs:

Average and adjusted kid body weights per doe from birth to 120 days of age.



Pearson Correlations between Age of Dam (AoD), Birth Type (Btype), Rearing Type (Btype), Colostrometer (ColM), Refractometer (Refr), Anti-freeze tester (AnFz), Birth (Bwt), 30-d, 60-d, 90-d, and 120-d weights.

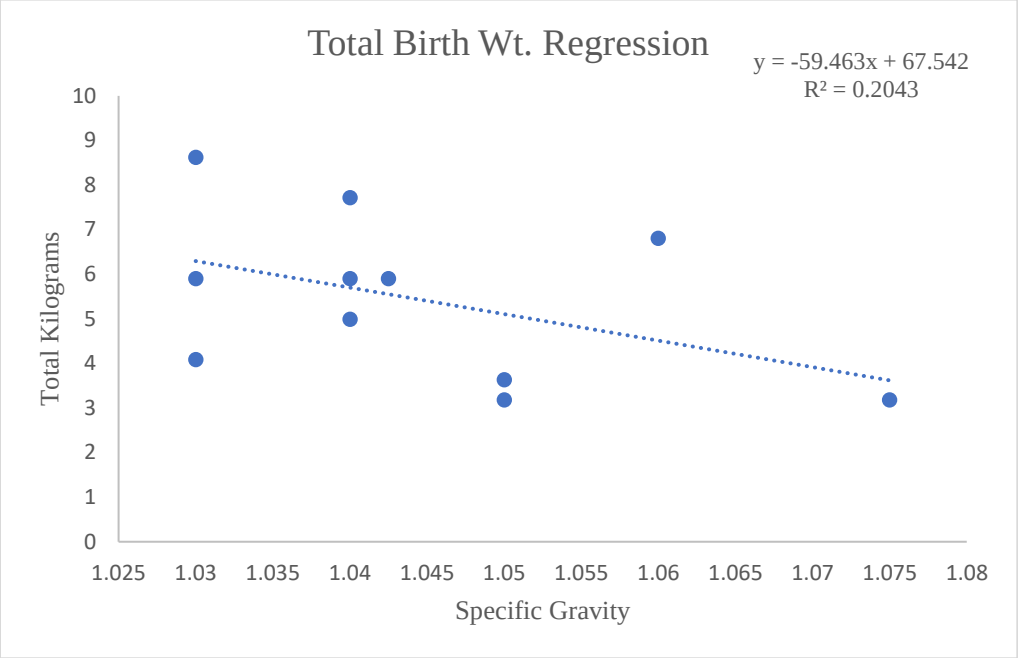
Correlations

	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 – (R > 0.4)

Red – (R > 0.5)

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



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