SUMMARIES OF RECENT JOURNAL ARTICLES

Energy expenditure by dry and lactating Alpine does estimated by entry rate of carbon dioxide

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Journal of Dairy Science 81:2469-2474. 1998.

Energy requirements of animals are affected by production state, such as lactating versus dry. Effects of lactation on energy requirements of goats as suggested by the National Research Council (i.e., NRC) are currently based on only four publications between 1938 and 1979. Energy requirements are studied by measuring feed intake and total heat production, which is the sum of energy used to maintain the animal and that produced in metabolism for growth, milk production, or greater than normal activity. Total heat production can be quantified by a number of approaches, although most have limited application in practical production settings, particularly grazing. The carbon dioxide (CO_2) entry rate technique has been developed, especially for grazing settings, as an indirect measure or index of CO_2 production in the body, which can be used to estimate heat production. However, very little information exists regarding the advantages and disadvantages of different body fluids that may be sampled in this method. Likewise, several equations have been published over the years to predict heat production from the CO_2 entry rate in small ruminants. In this experiment, the entry rate of CO_2 derived from use of continuous collection of saliva was less variable than that determined from urine, serum, or breath samples, indicating that saliva was most suitable. The entry rate of CO_2 was 34% greater for lactating does than for dry does, reflecting greater feed intake and milk production by lactating does. Energy requirements derived from the different equations tested yielded differed considerably, suggesting that the choice of equation warrants careful consideration and that further research is necessary to identify most appropriate equations for particular experimental or production conditions.

Adrenocortical response to ACTH in Angora and Spanish goat wethers

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Journal of Animal Science. In Press. 1999.

Angora goats, on a body weight basis, are the highest fleece-producing ruminant, but are susceptible to stress. Irrespective of sex, Angora goats exhibit an apparent impaired capacity for gluconeogenesis and a consequent inability to raise blood glucose levels under cold and(or) nutritional stresses. This may contribute to abortions and adult fatalities. It has been hypothesized that the decreased gluconeogenic ability of Angora goats is simply due to nutrient partitioning to fiber production at the expense of labile body protein reserves and glucogenic precursors. However, subclinical hypoadrenocorticism could exist in Angora goats as well. Likewise, it has been postulated that genetic selection for mohair production has been accompanied by coselection for hypoadrenocorticism, since cortisol inhibits fiber follicle activity. In primary hypoadrenocorticism, low cortisol production and blood levels result from low adrenal cortisol release in response to adrenocorticotropin hormone (ACTH) stimulation, because of factors such as low adrenal mass and atrophy or destruction of the adrenal cortices; secondary hypoadrenocorticism is the product of low pituitary ACTH production. Integrity of the adrenal cortex of Angora goats has not been directly studied. Thus, in this study the hypothesis that Angora goats exhibit subclinical primary hypoadrenocorticism was tested by measuring plasma cortisol response in stress-tolerant Spanish and stress-intolerant Angora goats under conditions of simulated acute and chronic ACTH challenges. Based on results of this experiment, the adrenal cortex in Angora goat wethers appears fully capable of mounting an appropriate cortisol response to adrenocorticotropic hormone stimulation. Thus, the ability of Angora goats to cope with stress may involve factors other than the capacity of the adrenal cortex to produce cortisol. However, possible changes in hypothalamic-pituitary-adrenal cortex axis function due to pregnancy and(or) dysfunction in cell-signaling mechanisms for cortisol action may play a role in the well established stress intolerance of Angora goats.

Dietary protein effects on and the relationship between milk production and mohair growth in Angora does

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Small Ruminant Research. In Press. 1999.

Recently farmers in the central and midwestern U.S. have shown interest in using traditional crops and land for production of mohair from Angora goats as a means of diversification. Angora goats are valued primarily for mohair production, but income also arises from the sale of kids. Thus, there is need for both high milk production to promote maximal kid live weight gain and an ample supply of nutrients to skin for rapid mohair growth. However, wool growth is markedly decreased in lactation because of nutrient partitioning to the mammary gland for milk synthesis. Angora goats are the highest fleece-producing ruminant on a body weight basis; therefore, there also may be a negative relationship between milk production and fiber growth in Angora goats, although one has yet to be reported or characterized. Relatively low milk production by Angora goats and a short lactation period indicate that lactation could impact mohair growth differently than that of sheep wool. Furthermore, to avert or minimize a potential decrease in mohair growth as a result of a priority for nutrient use by the mammary gland, and because requirements for amino acids, particularly those containing sulfur, are high in Angora goats, an increased level of dietary crude protein may be beneficial. In this regard, increasing dietary crude protein level has increased mohair production by nonlactating Angora goats, as has skin perfusion of amino acids. Hence, the primary objectives of this study were to measure the relationship between, and dietary crude protein level effects on, milk production and mohair growth by Angora does in different periods of lactation. Based on results of this experiment, milk production by Angora does in wk 3 through 16 of lactation increased linearly with increasing crude protein level in a diet with a high concentrate level. Crude protein intake was correlated with milk production but not with live weight gain or mohair growth. Milk production and mohair growth were negatively related in mid-lactation but not in early or late stages, but dietary crude protein level did not alter the relationship between milk production and mohair growth. Under our conditions, varying the dietary crude protein level did not overcome effects of partitioning of nutrients to milk synthesis in lactating Angora does or increase mohair growth by increasing skin nutrient supply.

Effects of bovine somatotropin and ruminally undegraded protein on feed intake, live weight gain, and mohair production by yearling Angora wethers

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Journal of Animal Science. In Press. 1999.

Effects of growth hormone on wool growth are variable. Exogenous ovine growth hormone generally depresses wool growth during the period of administration, although bovine somatotropin (bST) has increased wool growth by sheep during and after treatment. A biphasic response in wool growth to bST treatment has been reported, with a decrease during treatment but an increase thereafter; the decrease during treatment was largely a result of reduced fiber diameter. Effects of bST on mohair production by Angora goats have not been extensively studied. Source of dietary protein can impact magnitudes of response in animal performance to bST. For example, bST effects on average daily gain, feed efficiency, and hind limb muscle mass were greater for diets formulated with fish meal, to elevate ruminally undegraded protein, compared with diets containing soybean meal. Comparable interactions in milk production by lactating dairy cows have been observed as well. Interactions in fiber growth by Angora goats may differ from those for lactating dairy cows or growing sheep or cattle. Effects of growth hormone on nutrient partitioning are not skin- or fiber-specific; nutrient requirements for fiber growth differ from those for milk synthesis and accretion of peripheral muscle; and body composition, which impacts potential nutrient partitioning properties of bST, varies among animal types. Therefore, the objectives of this study were to investigate effects and interactions of bST treatment and dietary level of ruminally undegraded protein on feed intake, average daily gain, and mohair production by yearling Angora wethers. Based on results of this experiment, dietary addition of ruminally undegraded protein can increase mohair production by yearling Angora goats with and without somatotropin treatment. Treatment with somatotropin does not appear promising as a means to increase mohair production by yearling Angora goats regardless of dietary concentration of ruminally undegraded protein. However, somatotropin can influence change in feed intake by Angora goats elicited by dietary inclusion of ruminally undegraded protein, thereby impacting the ratio of fleece production to feed intake.

Effects of zinc-methionine on performance of Angora goats

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Small Ruminant Research. 1999. In Press.

The essential amino acids lysine, methionine (Met), and cyst(e)ine stimulate wool and mohair growth. Omission of Met reduces wool growth and decreases both length growth rate and diameter. Skin and fiber (wool, mohair) impose heavy demands on the utilization of circulating sulfur amino acids. It has been predicted that 80% of the total free blood pool of combined cysteine and Met would be used for fiber growth. Being responsible for the initiation of protein synthesis, Met is important in fiber growth. Met can be converted to cystine mainly in the liver, but also to some extent in other tissues. Supplementation with specific amino acids has influenced mohair growth in Angora goats. It may be cost effective to increase absorption of most limiting amino acids such as Met through dietary supplementation of specific amino acids, rather than increasing absorption of a large number of amino acids through increasing of the total dietary CP level. Apart from the major nutrients such as protein, many vitamins and trace elements are essential for fiber growth. Zinc (Zn) functions directly in the process of wool growth**;** thus, Zn deficiencies can seriously affect wool growth. Zinc is needed for the functions of over 100 enzymes, and essential for DNA, RNA, protein synthesis and, as such, cell division. It has been suggested that primary impact of Zn deficiencies on wool growth is through impaired protein synthesis. Commercially available Zn-Met complexes provide both Zn and Met. If Zn-Met is absorbed and transported without modification, the complex may provide a means of increasing tissue supply of Met, which should increase animal productivity when Met is limiting. Therefore, objectives of this study were to investigate effects of dietary supplementation with Zn-Met (Zinpro 40, Edina, MN) or zinc oxide on mohair growth, BW gain, and concentrations of blood metabolites in Angora goats. Dietary inclusion of supplemental Zn-Met, regardless of level increased live weight gain in yearling Angora goats, but only numerically increased mohair production with a basal diet adequate in Zn. Live weight gain was greater for goats supplemented with the same quantity of Zn in the form of Zn-Met vs ZnO, even though plasma Zn concentration was similar. In conclusion, with an 11% crude protein, Zn-adequate diet, 1 g Zn-Met may offer little or no potential to improve fiber production by Angora goats.

Effects of mimosine and 2,3-dihydroxypyridine on fiber shedding in Angora goats

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Journal of Animal Science. 1999. In Press.

Leucaena (*Leucaena leucocephala*) is widely used as a forage for livestock in tropical and subtropical regions. However, seeds and leaves are high in mimosine, a toxic, nonprotein amino acid-like compound, which causes alopecia in various species and fiber shedding in sheep. Mimosine has been extensively studied in Merino sheep as a potential chemical defleecing agent. Though mimosine is rapidly removed from the body, intravenous infusion for 2 d at 80 to 100 mg/(kg body weight · d) has consistently caused fiber shedding 7 to 10 d after treatment commenced. This level of infusion yielded a plasma mimosine concentration of approximately 100 Fmol/L. Sheep can also be defleeced by single oral doses of 400 to 600 mg/kg body weight of mimosine, raising plasma mimosine concentration to greater than 100 Fmol/L 24 h after dosing. In the rumen, mimosine is converted to 3-hydroxy-4(1H)-pyridone (DHP), which is not depilatory in sheep. Some 3,4-DHP may be further converted to 2,3-DHP, and depilatory properties of 2,3-DHP have not been examined. Mimosine, or other defleecing agents such as epidermal growth factor, may be useful for removing fiber of Angora goats as well as of sheep. In this regard, in an experiment at the E (Kika) de la Garza Institute for Goat Research, five Angora goats were intravenously infused with mimosine for 2 d at 75 mg/(kg body weight · d), which is slightly less than the level commonly used for sheep. Fiber growth was unaffected in two goats, but there was partial or complete alopecia within 10 d in the other three goats. In another Institute study, mohair fiber growth was not affected and defleecing was not induced by 3-d perfusion of a local area of skin of Angora goats with mimosine at 20% of a whole animal defleecing dose for sheep. Objectives of the present study were to determine efficacy for removing fiber of Angora goats by 2-d intravenous infusion of different levels of mimosine or one level of 2,3-DHP. Effects of two levels of an oral dose of mimosine were also investigated. Based on results of this experiment, mimosine is a depilatory agent for Angora goats. Two-day infusion of Angora goats with levels of mimosine similar to those effective for defleecing in sheep were effective in removing Angora fiber. However, mimosine may not remove all Angora fibers, particularly primary fibers, when in a temporary resting phase. Oral mimosine administration at doses effective to defleece sheep may be less efficacious with Angora goats. Further research is required to fully characterize seasonality of follicle activity for Angora goats in the United States to most effectively use compounds such as mimosine to defleece, and to develop practical means of mimosine delivery, such as feeding of *Leucaena leucocephala*.

Effects of mimosine on plasma amino acid concentrations in Angora goats

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Small Ruminant Research. In Press. 1999.

The naturally-occurring amino acid mimosine causes alopecia in Merino sheep and Angora goats. Mimosine appears to act as an antimitotic agent, but various other possible biochemical effects have been noted as well. Mimosine is degraded in the rumen to 3,4-dihydroxypyridine (3,4-DHP), some of which may be further converted to 2,3-dihydroxypyridine (2,3-DHP). Neither compound causes alopecia in sheep or goats, although 3,4-DHP inhibits cell division in wool follicle bulb cells *in vitro*. Mimosine may interfere with some aspects of amino acid metabolism. For example, it has been suggested that mimosine acts as a tyrosine analogue and reported that mimosine inhibits activity of some enzymes involved in tyrosine metabolism. It has also been observed that mimosine included in the diet of rats reduced serum tyrosine concentration. Mimosine inhibits activity of pyridoxal-requiring enzymes and, thus, could decrease methionine conversion to cysteine via the transulfuration pathway. In accordance, in recent studies with Angora and Alpine goats both mimosine and 2,3-DHP influenced plasma amino acid concentrations. Parenteral administration of mimosine or a perfusion of an area of skin reduced concentrations of some amino acids in plasma, but effects were variable. However, blood levels of mimosine in these studies were less than required to defleece sheep (i.e., 100 Fmol/L) and did not induce fiber shedding. The administration of 2,3-DHP increased plasma concentration of some amino acids). Mimosine holds promise as a means of inducing shedding. In order to eventually employ mimosine as a chemical defleecing agent, research is needed, such as to develop practical means of delivery and to thoroughly understand all other physiological changes elicited. Consequently, objectives of this experiment were to examine influences of 2-day infusion of mimosine, adequate to defleece, and of oral dosing of mimosine on plasma concentrations of amino acids in Angora goats. Based on results of this experiment, physiological effects of mimosine when infused in Angora goats for 2 days at levels that defleece include altered plasma concentrations of some amino acids. However, based on oral doses of mimosine, such effects appear relatively short-term or -lived. In general, responses to mimosine infusion and dosing seem threshold in nature, involving both mimosine plasma concentration and length of time that plasma mimosine concentration is above thresholds. The pattern of change in plasma mimosine concentration due to oral dosing varied considerably among amino acids, implying alteration of various physiological processes or perhaps different threshold mimosine levels or periods of time of elevated plasma mimosine necessary for effects. In order to eventually use mimosine as a practical means of defleecing, further research is necessary to determine production impacts of mimosine on plasma amino acid levels and, if necessary, modes of preventing consequent adverse effects, such as supplementation.

The effect of bovine somatotropin (bST) on production of lactating Angora does with kids

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Journal of Animal Science 77:17-24. 1999.

The galactopoietic effects of bovine somatotropin (bST) in dairy cattle, sheep, and dairy goats are well established. The milk yield response to bST treatment in goats and sheep is more variable than that in cows. Bovine somatotropin also has been shown to positively affect growth, carcass composition, and wool fiber production. Variable results have been obtained for fiber production response to growth hormone (GH) treatment. Fiber growth was unchanged, decreased, or increased in sheep during GH treatment. In the recovery period after GH treatment, wool growth was reported to be similar to or greater than that in control sheep. To date no studies have been reported on the effect of bST on mohair or milk production in Angora does. In the present study, data were collected to determine whether bST treatment of lactating Angora does would affect preferentially the partitioning of nutrients towards fiber or milk production either during the period of bST treatment or in the period after bST treatment. However, results of this experiment do not depict potential to enhance mohair production through slow release bovine somatotropin treatment of Angora does. Growth by suckling kids may be enhanced, although cost effectiveness of the treatment is unknown.

Effects of level of feed intake on body weight, body components, and mohair growth in Angora goats during realimentation

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Small Ruminant Research. In Press. 1999.

Angora goats are the highest fleece-producing ruminant on a body weight basis. As with wool-producing sheep, poor nutrition affects mohair production by Angora goats, as well as affecting gain or maintenance of body weight. Pastures for Angora goats vary widely with season and rainfall in quality and available forage mass, often resulting in seasonal reductions in mohair growth, body weight, and body condition. Mohair production and body weight can be increased during periods of poor grazing conditions by supplementation, though with associated monetary and labor inputs. Hence, a better understanding of effects of nutrition on mohair production could lessen production costs or increase productivity of Angora goats. On a long-term basis, changes in mohair production and body weight elicited by nutritional plane and supplementation are positively related. However, physiological processes controlling body weight gain and mohair growth differ. Thus, short-term periods of nutrient restriction may have dissimilar magnitudes and durations of effects on body weight and mohair growth. Hence, objectives of this experiment were to evaluate mohair growth and BW change during and after different levels of feed intake restriction. Based on results of this experiment, different levels of restricted feeding of a 14.7% crude protein, 70% concentrate diet for 40 days decreased mohair growth in the last 20 days of the restriction phase and also in the last 21 days of the subsequent 41-day realimentation phase, even though body weight change in the latter part of realimentation increased with increasing severity of previous feed intake restriction. In conclusion, feed intake restriction can have longer term effects on fiber growth than body weight change, suggesting that special attention being given to avoiding even short-term periods of low feed intake if maximal fiber production is to be achieved.

Heat energy for growing goats and sheep grazing different pastures in the summer

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Journal of Animal Science. In Press. 1999.

Heat energy produced by grazing ruminants is thought to differ with environmental conditions, including land area and types of herbage available. Behavioral differences between sheep and goats could impact heat energy during grazing, thereby limiting applicability of heat energy due to activity of sheep to goats. Currently, the National Research Council increases the metabolizable energy requirement of all goats for maintenance by 25% with light activity, 50% with semiarid rangeland and slightly hilly conditions, and 75% with sparsely vegetated rangeland or mountainous transhumace pasture. However, differences among forage systems typical of goat production conditions in the U.S. or among ruminant species or breeds of a particular species are largely unknown. In part, this relates to the difficulty with which heat energy by grazing animals can be studied. Production of CO_2 and heat energy are directly related. Thus, heat energy of ruminants has been studied by continuous infusion of isotopes of sodium bicarbonate ($NaH^{14}CO_3$ or $NaH^{13}CO_3$) and determining the ratio of labeled to total carbon in the CO_2 pool at equilibrium. This technique, known as carbon dioxide entry rate, has been employed to estimate heat energy of grazing sheep and cattle. The objective of our experiment was to investigate influences of animal type (i.e., Angora goat, Spanish goat, and Suffolk × Rambouillet sheep wethers) on heat energy during summer grazing (mid-August through September in Oklahoma) of two different types of grass-based pastures. In summary of results of this experiment, with nonlimiting available herbage mass and similar quality of available herbage, pasture treatments such as in this experiment may not have marked effect on energy intake relative to the maintenance energy requirement of ruminants. However, there appears to be appreciable potential impact on the quantity of energy used for maintenance. The absence of interactions between pasture treatment and animal type in heat energy and the difference between metabolizable energy intake and heat energy suggests that grazing conditions of improved and native pasture treatments would similarly impact productivity by goats and sheep and by different goat breeds. In conclusion, pasture treatments can impact summer energy expenditure by ruminants, at least in part through grazing time. Heat energy of growing ruminants during summer grazing was less for goats than for sheep regardless of paddock size or specific grasses present in the pasture and being consumed. Animal type can impact the increase in heat energy as energy intake rises with increasing grazing time.

Growth of Spanish, Boer × Angora and Boer × Spanish goat kids fed milk replacer

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Small Ruminant Research. In Press. 1999.

Contributions of heterosis for economically important traits have been well documented in other species. The Boer goat has long been recognized for its superior meat producing ability and is widely used to improve growth and carcass traits of local breeds through crossbreeding. It has been noted that Boer crossbred kids were 15 to 20% heavier at weaning than purebred kids of the dam breed. Greater BW and BW gain for Boer crosses than for Spanish goats also has been reported, although feed efficiency was similar. Under an extensive management system, Boer crosses (Alpine, Spanish and Tennessee stiff-legged goats used as maternal breeds) were heavier at 4, 8 and 12 wk of age compared with purebred Boer goats, although the advantage diminished postweaning with advancing age. However, a computer simulation suggested that Boer goats may not excel in growth and reproduction under extensive management conditions, implying genotype × environment interactions. Though performance of Boer goats under extensive management systems has not yet been well characterized, benefits in offspring performance with Boer use as a terminal sire breed under intensive management conditions are generally accepted. Acidified milk replacer has been widely used in rearing young calves and kids, with advantages of reducing milk feeding and labor costs and simplifying management. Kids fed cow milk replacer can grow as rapidly as kids given goat or cow milk. Milking ability of the dam can greatly influence the opportunity of kids to express growth potential; therefore, hand-rearing eliminates such maternal effects. However, information is lacking on how performance of Boer crosses compares with Spanish goat kid performance during the preweaning period under identical feeding and management conditions, such as with feeding of milk replacer. Therefore, the objective of this study was to compare preweaning performance of two Boer crossbreds and Spanish goats under standardized nutritional conditions - feeding acidified milk replacer in an intensive management system. In summary, Boer × Angora kids consumed more milk replacer from birth to 3 wk of age than did BS and S kids, although intake was similar among genotypes in wk 3 to 8. Starter diet intake was greatest among genotypes for BS, and the feed conversion ratio was 13% greater for Boer cross kids than for S kids. This study reflects that Boer crosses exhibit superior growth and feed efficiency during the preweaning period compared with Spanish kids under intensive management conditions.