Nutrition and feeding: the type of nutrients required by Markhoz (Iranian Angora) goat

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Abstract: Goats are known to be both more able and more willing than some species to select and consume a wider variety of material and to select those plants or plant parts having higher nutritive value.The type of nutrients required by all animals is essentially the same and these are energy (carbohydrates, fat), protein, minerals, vitamins and water. Although fat is shown here as an energy source there does appear to be a limited requirement for fat itself, but this is not considered to represent a problem. These nutrients provide the raw materials or resources for body maintenance, muscular activity, growth (meat production), reproduction as well as milk and fiber production. Nutrients interact to serve different functions which will be reviewed briefly. Energy is obtained from dietary carbohydrates (sugars, starch and fiber) and fats. Protein is the nutrient which might be considered the second most limiting for both fiber and milk production in the Angora goat. Vitamins are a group of compounds which are required in minor amounts. Generally these are grouped as the fat soluble vitamins (A, D, E and K) or the water soluble vitamins (C and the B complex group).
[Tofiq Froghi, Azad Hosaini. **Nutrition and feeding: the type of nutrients required by Markhoz (Iranian Angora) goat**. *Life Sci J* 2012;9(4):334-338] (ISSN:1097-8135). http://www.lifesciencesite.com. 51

Keywords: Nutrition; Feeding; Markhoz goat

1. Introduction

Both magic and mystery are sometimes attributed to the goat in respect to nutrition or feeding habits. Actually the animal is merely a small ruminant, and except for size, it functions much as any other ruminant Devendra, (1978). The same basic principles of nutrition apply to the goat as other ruminant species, and these principles will be reviewed only briefly in this discussion. However, the goat in general, and especially the Angora, does have some unique aspects which warrant mention. Many perceive the goat to be a scavenging or "tin can" eating animal which can survive on almost anything. By contrast research has shown the Angora to have a high nutritive requirement relative to other domestic ruminants. At the same time it has been reported that the goat has a superior ability to digest poor quality forages. Likewise different breeds of goats have been reported to have a low or a high requirement for protein. Clearly some of these contradictions need to be resolved before a logical treatment of the subject on the nutrition of the goat can proceed. The apparent controversy relating to the digestive ability of the goat appears to be explainable. The ability of a ruminant species to digest forages is greatly influenced by the time these materials remain in the digestive tract. In animals with a large rumen capacity, such as a beef cow, the feedstuffs remains in the tract for a longer period of time than some other animals such as a deer and certain types of goats which have a low volume of the digestive system. The latter apparently make up for this by being more selective grazers thus consuming a higher quality diet and in some cases passing ingested material through the digestive system at a more rapid rate. Thus they often consume a larger amount of material relative to body weight (Huston, 1978). This can have the effect of showing the animal to have a reduced ability to digest structural carbohydrates, but to work to the animal's overall advantage.

Goats are known to be both more able and more willing than some species to select and consume a wider variety of material and to select those plants or plant parts having higher nutritive value.

Problems tend to be encountered when the ability of the goat to be selective is restricted such as a monoculture or a restricted variety of plant species which does not meet their nutrient requirement. The apparent inconsistency relating to protein requirements appears to be explained in that at maintenance or subsistence levels goats appear to be able to maximize the recycling of nitrogen (urea or ammonia) and thus to survive on a low level of protein. However, the protein requirements for production of meat, milk or fiber does not appear to be less for the goat than for other species and may actually be higher. This is almost certainly true of the Angora. The apparent ability of the goat to recycle nitrogen (Bryant et al., 1979) suggests that this animal may have a superior ability to utilize nonprotein nitrogen. Some studies suggest that this is the case, but this is not currently being exploited by the industry. Other unique aspects of the Angora have to do with the demands associated with fiber production. The Angora goat is an animal breeding success story in that they produce a high level of

fiber relative to body size and feed consumed. Selection for high fiber production has certainly elevated their requirements for protein, energy, and possibly other nutrients. On a world basis, large differences exist within the Angora in inherent levels of mohair production. Thus, one would expect differences in nutrient requirements related to different levels of fiber production. Observations strongly suggest that the goats found in some areas such as Turkey and Lesotho normally receive a lower quality of ration, but at the same time have a lower genetic potential. Apparently the Angora found in the U.S. has the highest genetic potential for fiber production and the problems rising from this. Most of the discussion to follow will be based on data and experience obtained under Texas conditions. Although the Angora goats in Texas may well have unusually high nutritive requirements, they are often run on ranges which after long use by goats do not have the quality or nutrient content to meet their requirements. The result is a goat which is almost perennially undernourished unless they are appropriately supplemented. It has been estimated that the normal weight for mature Angora does is on the order of 85 pounds, whereas, many does found in market channels tend to weigh on the order of 65 pounds. It may be argued that these are culled animals, and that herd does are larger, but it is obvious that only a small percentage of the does ever reach optimum size. The first result of under-development is reduced reproductive performance. In addition death losses among these underdeveloped does may increase due to nutritional, parasitic or climatic stress. Although reduced by poor nutrition, fiber production will continue until the animal dies of starvation and the quality, or more properly fineness, of the fiber will improve under conditions of poor nutrition. However, this statement applies to diameter only as length and weight will be reduced and the fleece will often be matted and difficult to shear or process.

2.Required Nutrients

The type of nutrients required by all animals is essentially the same and these are energy (carbohydrates, fat), protein, minerals, vitamins and water. Although fat is shown here as an energy source there does appear to be a limited requirement for fat itself, but this is not considered to represent a problem. These nutrients provide the raw materials or resources for body maintenance, muscular activity, growth (meat production), reproduction as well as milk and fiber production. Nutrients interact to serve different functions which will be reviewed briefly.

3.Energy

Energy is obtained from dietary carbohydrates (sugars, starch and fiber) and fats. The Angora goat is a ruminant with a large microbial population in the rumen. The microbial population requires carbohydrates for growth. They ferment both fibrous and grain based diets into compounds called volatile fatty acids (acetate, propionate and butyrate) that are readily absorbed through the rumen wall to be utilized by the host animal for energy. Grain based diets are more readily fermented in the rumen than fibrous based diets and thus tend to produce more energy. The fiber in immature plants is more readily fermented than mature plants. Thus, most grazing animals go through an annual cycle of weight loss and weight gain associated with season-based changes in maturity and availability of forages. They exhibit a cycle of depositing excess energy in the form of body fat during the spring season and gradually mobilize their stored fat during the fall and winter when feed supplies are scarce. Unfortunately, Angora goats store relatively little body fat, and for this reason the Angora is more susceptible to nutritional stress at the time of unfavorable feed conditions. This does not mean that Angoras will not fatten, but that due to their high nutrient requirements a higher quality diet is required to permit fat deposition. Fats are a concentrated form of energy (2¼ times energy of carbohydrates) and therefore, adding fats to the ration is a very efficient way of increasing caloric density of the diet; however, there are some adverse affects of fat addition. Polyunsaturated fatty acids are apparently inhibitory to microbial growth, resulting in reduced fermentation of fiber in the rumen. Not more than 3 to 5% unprotected dietary fat appears to be well tolerated by ruminal micro-organisms. Whole cottonseed (20% fat) has been used successfully as an energy supplement for Angora goats, but high levels may cause a reduction in fiber digestibility. It is recommended that whole cottonseed be limited to no more than ¼ the total diet.

4.Protein

Protein is the nutrient which might be considered the second most limiting for both fiber and milk production in the Angora goat. Proteins are made up of amino acids. The animal's tissue level requirement is for individual amino acids. The two main sources of amino acid supplies to the animal are; microbial protein synthesized in the rumen and dietary proteins and amino acids which escape ruminal degradation. If energy is not limiting, rumen micro-organisms appear to provide sufficient protein for maintenance, slow growth, and early pregnancy. Animal fibers (wool, mohair, etc.) are pure protein.

Thus, a high-producing Angora goat has a high protein requirement, compared to other ruminant species, and will respond to increased dietary protein with increasing fiber production up to 20% of the ration Sahlu and Fernandez (1992). However, it may not always be desirable to feed for maximum fiber production. Thus, the choice of level of protein in the ration or in the supplement is an economic as well as nutritional consideration. Complete rations are seldom formulated to contain more than 16% protein, but in commercial practice goats are seldom fed complete rations. Most feeding is in the form of energy or protein fed as a supplement to range forage, and under these conditions, protein concentrates of 20 to 40% are generally used. The kind or quality of protein consumed by ruminants, including the Angora, is not considered to be particularly important. This is a general statement to which there are some exceptions. The very young kid may function as a pre-ruminant and thus respond to good quality protein. Animal fibers such as mohair contain a higher percent of the sulfur containing amino acids (methionine and cystine) than other body tissues, and the availability of these amino acids at the tissue level frequently limit fiber production. Unfortunately, if these are fed in the ration they are normally broken down in the rumen and do not reach the tissue level where they might be directly used as building blocks for fiber synthesis Malechek et al., (1972). Mohair production appears to be dependent on and limited by the rate of synthesis of these sulfur containing amino acids. It is important that goat rations contain an adequate level of available sulfur. The term available is important. In most cases browse makes up an important part of the diet of the goat. Many of these plants contain tannic acid, or other compounds such as lignin, which tie up much of the protein, rendering it somewhat indigestible. The result may be not only a protein insufficiency, but a deficiency of sulfur as well if the sulfur is unavailable. If goats are fed nonprotein nitrogen (such as urea) then the need for sulfur for protein or fiber synthesis is obviously important. The recommended level of sulfur is usually expressed as a ratio of nitrogen to sulfur. This is normally stated as something on the order of 15:1, but there is reason to believe this should be no higher than 12:1 for fiber producing animals. In the case of goat feeds it should be this high or above. Qi, *et al*. (1992), estimated that the total ration should contain .23-.29% sulfur. The preferred source of sulfur would likely be in the form of s-containing amino acids, elemental sulfur or in the sulfate form such as ammonium,potassium, calcium or sodium sulfate. In the normal scheme, amino acids presented at the tissue level for meat, milk and fiber production are derived mainly from microbial protein synthesized in the rumen and dietary protein that has escaped degradation in the rumen. Production efficiency would potentially be improved if a significant proportion of these feed proteins could get through the rumen without being degraded. This would be especially true with respect to mohair production if the protein feeds used were made up of high quality protein, rich in limiting amino acids such as methionine. It is more important that these sulfur containing amino acids are fed in a form which prevents rumen degradation. It has been shown that fiber production (wool or mohair) can be increased by as much as 20% through the use of rumen by-pass proteins (see Figure 5-1). At present there are methods of coating amino acids or protecting proteins to increase the amount which escape ruminal degradation. Although this can be done on a laboratory scale, it has not yet been used extensively in practice. Some proteins found in nature tend to be slowly digestible, and a portion of these tend to get through the rumen intact. This is true of some of the browse (tannic acid containing forages) species utilized by goats with the result that the browsing goat may produce more mohair than a non-browser. Unfortunately many of these proteins are poorly digested and thus may not become available even past the rumen. The end result is that some browse species or protein supplements may stimulate fiber production, without beneficially affecting other body functions. Thus it may not be desirable to attempt to stimulate additional fiber production by this route unless overall nutrition is satisfactory. Some protein concentrates (blood meal, fish meal, meat meal or feather meal) are poorly or slowly digestible and thus have some rumen escape properties. Fish meal not only has escape value, but is also high in the sulfur containing amino acids and has been shown to be useful to increase fiber production. Since a small amount of readily soluble protein is necessary for microbial digestion of fibrous materials in the rumen it may often be desirable to provide at least a low level of readily available protein to stimulate ruminal action even when protein is available from other sources such as browse. Another option to increase fiber production can apparently result from a high level of protein feeding. This would not only supply any protein or amino acid needs, but may result in some spill over from the rumen thus providing a form of ruminal by-pass. Although a response from feeding a high level of protein or a high level of bypass protein can be expected it may not always be economic. In general it is more financially remunerative to use the most economical source of natural protein. Where protein supplements are comparable in price a mixed protein supplement might be preferable. There appears to be

an opportunity to make greater use of non-protein nitrogen (NPN) with goats than is being done at the present time. This statement is based on economic consideration and it is not meant to imply that the animals will actually do better on NPN sources.

5.Vitamins

Vitamins are a group of compounds which are required in minor amounts. Generally these are grouped as the fat soluble vitamins (A, D, E and K) or the water soluble vitamins (C and the B complex group). Ruminants are thought to be able to synthesize all except the fat soluble vitamins. Vitamin D is produced by the action of the sunlight on plant or animal tissues. A and E are widely present in plant or forage materials. Thus, vitamin deficiencies are unlikely with goats under normal grazing conditions. Vitamin A is the one most likely to prove limiting, but this will occur only under extreme conditions such as in young animals which have not experienced a growing season when green forage was available. Because of the remote possibility of a deficiency it is probably advisable to include Vitamin A in feed supplements for goats at the rate of 5000 I.U. or more per pound of ration. The cost is normally negligible. Where producers have knowledge of, or suspect that, a Vitamin A deficiency exists or where past history has shown a response to this nutrient, injections of Vitamin A would provide a quick response. A limited number of tests under Texas range conditions have not shown a response to injections of Vitamin A.

6.Minerals

Minerals are required by all animal species, and certainly the Angora goat is no exception. A number of mineral elements are required in relatively small amounts and deficiencies of almost any mineral can be serious. It is a mistake in management to allow mineral deficiencies to limit production since these can usually be provided at low cost. Very little research has been conducted on the mineral requirements of Angora goats, and even if this was not the case, results would tend to be area specific. The minerals which are considered essential for animals fall into two categories known as "macrominerals" (calcium, phosphorus, potassium, etc.) or those required in relatively large amounts and "microminerals" which are required in small amounts. There are a large number in the latter class which are considered essential. These are often required in such small amounts that they are difficult to study. Micromineral requirements are too complex to attempt to discuss at this point. Generally producers should be concerned about the minor elements only if they live in an area which is known to be low in specific elements such as iodine, selenium, etc. On the other hand many producers will choose to use a broad spectrum trace mineral mixture as a form of insurance. A large amount of research or experience might be required to conclusively confirm or deny that a response to some mineral elements might be obtained. When goats are managed on range or pasture the only major (macromineral) element with much likelihood of being deficient is phosphorus, but goats, like sheep, appear to have the ability to conserve phosphorus. A limited amount of research indicates that they are less likely to respond to supplemental phosphorus than are cattle. However, most dry range forages, especially grasses, are at least borderline in their phosphorus content for goats. When this is compounded with soil or moisture conditions which contribute to low phosphorus content, a deficiency of phosphorus for Angora is a real possibility or even probability. Thus provision of supplemental phosphorus could be recommended under many conditions. Many browse plants are high in mineral content and this, compounded by a habit of highly selective grazing, provides goats with some protection against mineral deficiencies. Fortunately most protein supplements contain a significant level of phosphorus or if this is not the case phosphorus should be added in the formulation of supplements. Still the provision of additional phosphorus during the non-growing season (for forage) should be considered good insurance. Two common sources of phosphorus are bonemeal and di- or monocalcium phosphate. The other mineral that might deserve special mention in connection with Angora goat nutrition is that of sulfur. This was discussed earlier in connection with protein. However, it is probably desirable that any mineral fed to goats should contain sulfur. Although information on the mineral requirements of the Angora goat is sketchy there is little evidence that mineral deficiency is a major problem or explains poor performance with this animal. In fact, it would be good news if we could identify a mineral element which when offered to the goat would markedly improve performance.

7.Water

Water is also a critical nutrient which should not be ignored. Goats can live with low intakes of water, especially when consuming green forage. However, they perform better when given access to clean and safe water. Still it may occasionally be possible or desirable to run goats in areas where water supply is restricted. This can be more easily done with goats than with other species such as cattle. It may be possible to run non-lactating goats on green forage without water, and even for lactating goats hauling water may not be a major chore. Goats

are often less willing to drink from foul or contaminated water sources such as earthen tanks. When Angora goats are forced to drink from earthen tanks they should be observed carefully for bogging. They are more likely to become trapped than other species especially when they have a full clip of mohair which may become weighted with mud or water.

Acknowledgements:

Authors are grateful to the Islamic Azad University, Maku Branch, Maku, Iran for financial support to carry out this work.

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9/19/2012